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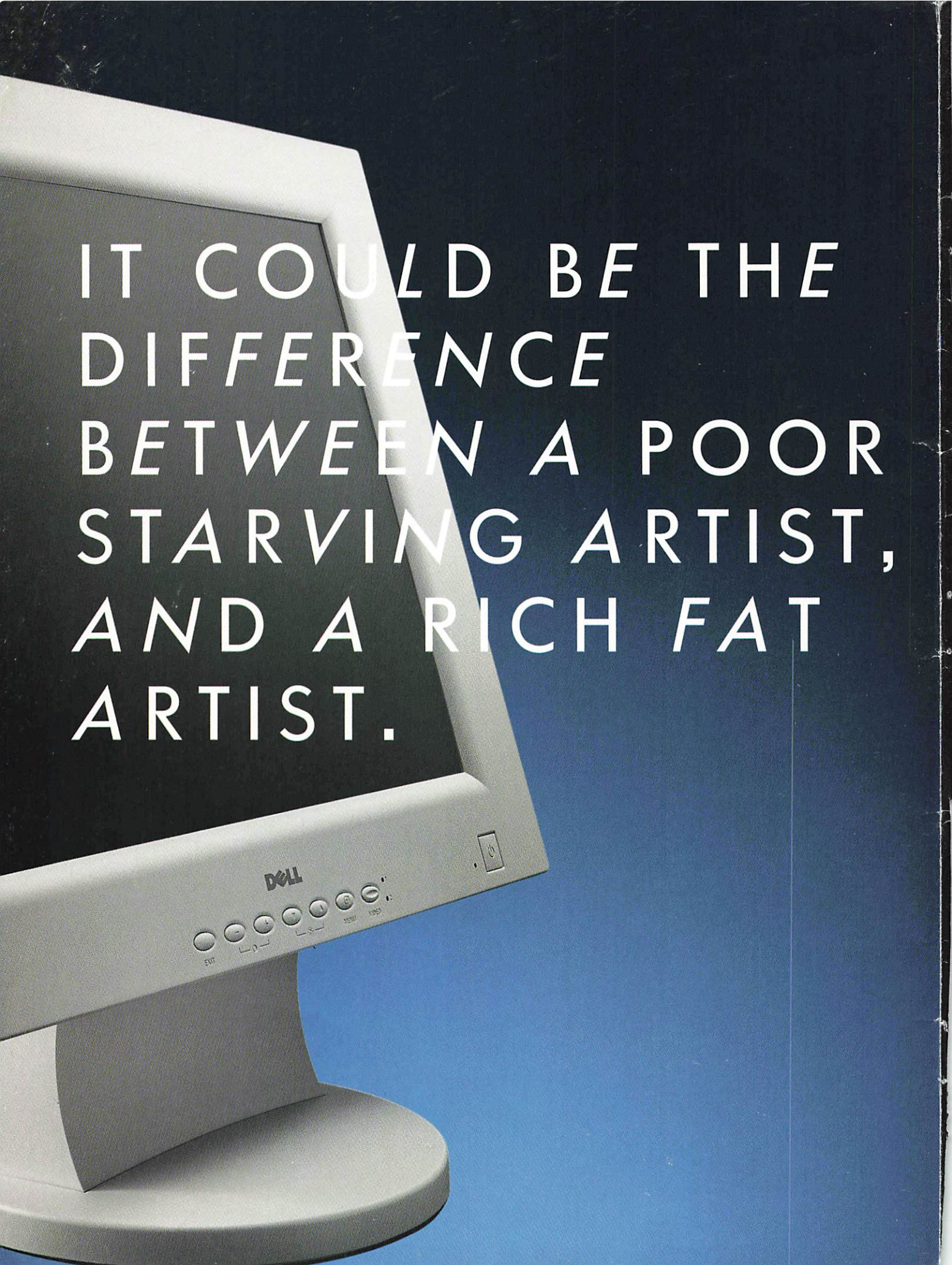
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3D

January 2000

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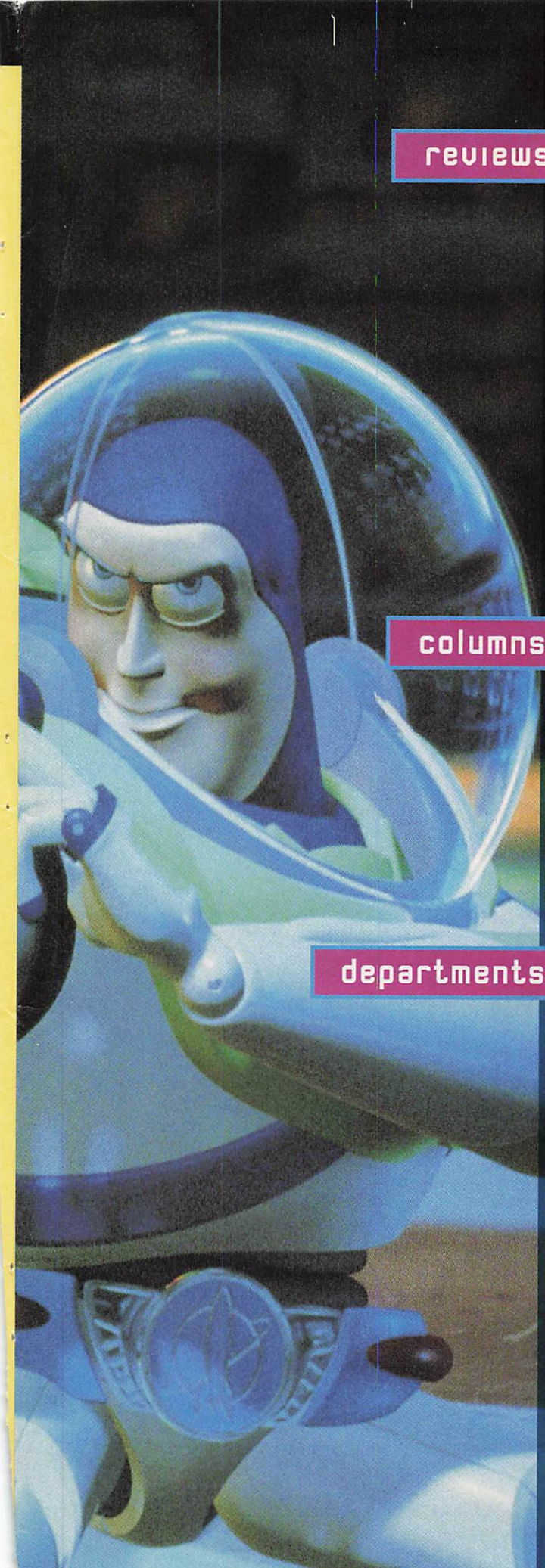

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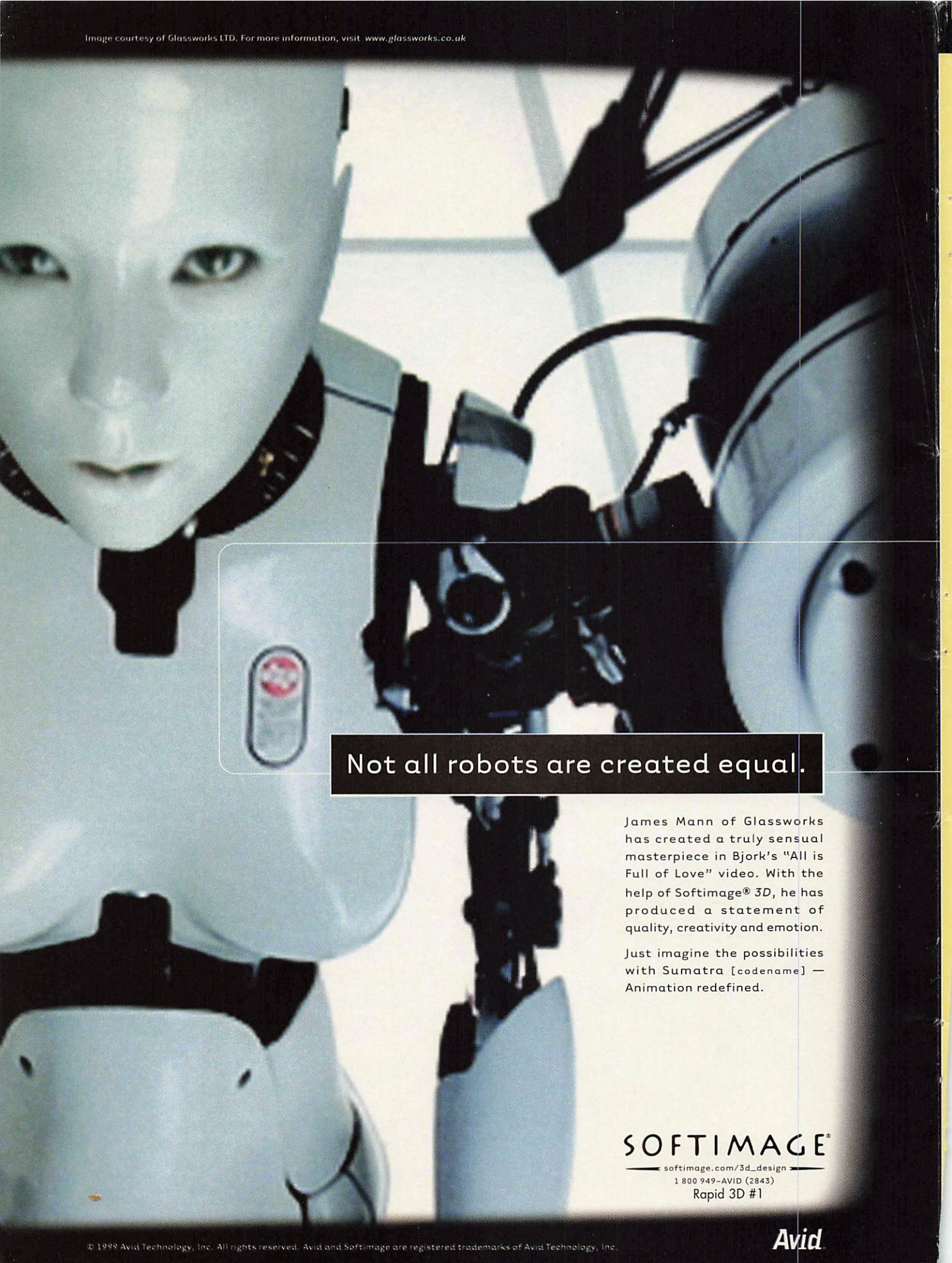
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A Taste of My Own Medicine

... with all due respect to those interviewed on p. 30.

If 3D in the year 2000 were a rock star, what rock star would it be?
The Artwork Formerly Known As Prints.

What's the most important use of 3D technology that hasn't yet been fully realized?
We all know it's virtual whoopie, but NewTek is the only company with the vision to push the concept forward (see p. 9). I'm counting on their extremely well-developed leadership to spur the industry to make it happen.

What will be the most important skills for professional artists and animators to possess in the coming decade?
Today, the most important skill is the ability to look up with glazed eyes from a computer screen depicting space creatures that look like slime-covered potatoes and utter the word "photorealistic" without cracking up. As processor speed rises and the applications mature, the successful artists will be the ones who can manage to press the Make-Art button while nobody's looking, and then keep themselves intensely busy surfing the web for 36 hours straight.

How will 3D graphics affect our everyday lives a decade from now?
Every web site will have a flying logo with a shiny metal surface. When you click on it, it will return a 404 error.

How would you describe your dream digital graphics system?
I dreamed about it last night, but I can't remember! I guess one that records and plays back dreams, so I can remember what my dream system was.

What milestone will signal to you that 3D technology is mature?
3D technology will be mature when the screen goes blue no more frequently than you need to get up to use the bathroom.

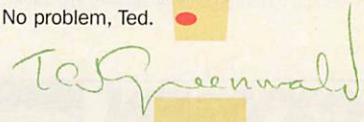
What's your wildest pie-in-the-sky vision of 3D graphics at the approach of the year 3000?
In a thousand years, all the problems of representing physically accurate forms, surface attributes, lighting, motion dynamics, and atmospheric interactions will be solved. But it will still be impossible to get a good cup of coffee in New York.

What I'm not sure about is whether artists will have come to recognize the responsibility they bear for the effects they have on their audience. At the Web3D RoundUP event at SIGGRAPH 99, Raza Zaibi, manager of Internet business development at Intel, kicked off the procedings with a story about playing with his child in the wake of the Littleton massacre. In what became the high point of SIGGRAPH for me, he delivered a plea to the creative community to approach their work with sensitivity to the broad range of people who might be touched by it and the broad range of reactions it might elicit.

Creation is the opposite of destruction; yet so much contemporary artwork is nihilist in spirit, or simply self-indulgent. I have no doubt that communication is contagious, and the more effective it is, the more it spreads. We have a responsibility to spread honest reflections of the human condition as we understand it, and to do so in a spirit of goodwill. Otherwise what we produce will be noise at best.

Just as text communication over the Internet has penetrated barriers of geography, politics, and culture, 3D in the future will be a medium in which people of disparate circumstances find common ground. It will enable individuals to see another person's point of view, literally, to understand how it relates to their own and to appreciate the limits of the individual's perspective. In this way, 3D will contribute to the increasing, and increasingly necessary, closeness of the human family. It's a tall order, but it's up to *3D*'s readers to show the way—after they've rebooted from the Blue Screen of Death, which gives no indication of going away any time soon.

Thanks for your time, Ted.
No problem, Ted.



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BY MATTHEW HOOVER

Studios Prosper, Chip Companies Stumble

Lots of work is being done in 3D, but the roster of chip and card vendors is shrinking.

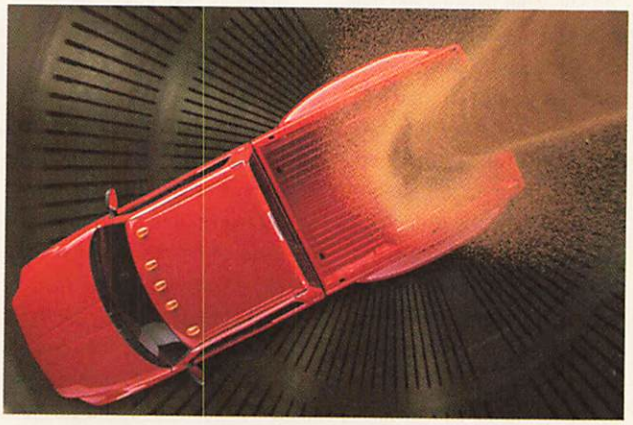
To show Six Flags executives and the public what the new Goliath roller coaster will be like, Liquid Light Studios of Los Angeles created a 3D animation of the entire ride. (Goliath climbs 255 feet and reaches 85 mph!) Park executives took the digital ride first, then it began airing on television. Two animators created the 2:30 spot with Discreet 3D Studio MAX on Intergraph TDZ 2000s. Digimation Glider was a helpful plug-in, according to executive producer Julie Pesusich, because it allowed for smooth motion of the coaster on the track. The whole coaster setting was digitally reproduced, with swaying palm trees, flying birds, and oozing smoke, and reflects the coaster's jungle theme and stomach-dropping speed. The coaster is scheduled to open in early 2000.

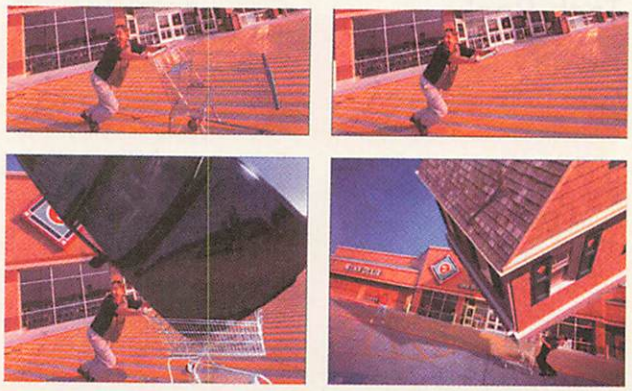
Digital Trucks A line of photorealistic CG pickup trucks are filled with particle-system sand from a giant hourglass, in a new commercial for Dodge Ram trucks created by Praxis Films and Station X Studios. With all the digital action and camera moves in the spot, Praxis founder Robert Blalack said the studio spent an extended amount of time on previsualization to solidify the visual elements and communicate the ideas clearly to the client. Once the previz was done, the creative was firmly nailed down and the production was limited to polishing the CG. "Hourglass" was created using NewTek LightWave 3D on NT and composited with Silicon Grail Chalice 1.6 at Station X in Santa Monica, CA.

Please, One Per Customer Janimation of Dallas completed a spot promoting Winn-Dixie grocery stores' sweepstakes, in which shoppers push carts filled with prizes such as a house and a Ford Explorer. For that effect, the crew built a full-scale Explorer out of cardboard and attached it to a cart to shoot for reference. To capture the feeling of extreme weight in the cart, they tied a rope to it so the actor had resistance while he pushed it. The rope and cart were painted out with Softimage Matador. The cart was replaced with a CG one, and a modified Viewpoint model of an Explorer was dropped in. Panoramic photos were used to make reflection maps on the truck, which adds to the shot's believability. Twelve passes of the truck were rendered out in Softimage 3D then combined and color-corrected to get realistic reflections.

Lord of Mocap Giant Studios will be supplying the motion-capture services for the forthcoming *Lord of the Rings* film trilogy from New Line Cinema, the studio announced. New Line contracted with Weta Ltd. of New Zealand to provide the VFX, and Weta named Giant the mocap resource.

A new venture, Giant Studios holds the license for Biomechanics Inc. Motion Reality capture system and tools (which used to be Acclaim Entertainment, but Biomechanics reclaimed the rights from Acclaim and went on to create Giant). Giant sees itself as a service group, combining the usually distinct roles of mocap





Liquid Light created a virtual roller coaster for Six Flags' new Goliath ride (top). Praxis and Station X built Dodge trucks from pixels and filled them with particle sand (middle). Janimation filled a shopping cart with CG prizes.

developer and service bureau.

Virtual Deep Space Superscape has created an interactive 3D solar system for National Geographic's web site (www.nationalgeographic.com). Visitors can see a model including the sun casting light and shadows, distinct and accurate models of each planet and their orbits, plus lots of data. It's viewable with Windows browsers but requires the free Viscape SVR plug-in. The presentation is rich with information and as visually accurate as possible, with exceptions: "To show the planets and their orbits on their true scale would require a computer monitor the size of a parking lot," the site explains. "And even then, the planets themselves would be seen as merely a few pixels, at best." To fit all the planets and satellites in a single view, the planet-sun distances are scaled logarithmically relative to the Earth-sun distance.

Tech Rocks, Reality Bites

As the advancements continue in the technology for pushing polygons, new chipsets for graphics accelerator cards are on the horizon: S3 Savage 2000, Napalm (codename for the 3dfx Voodoo3 successor), nVidia GeForce, the not-yet-seen SGI Cobalt II, and others. But the market for graphics accelerators is also at a point of slower growth and lower profits, so much so that some once-promising vendors are folding. Although price and performance are important, end users should consider the stability of manufacturers. It's harder to get support and driver updates from shuttered companies.

October 1999 saw the collapse of Real3D, developer of the Intel 740 chipset and RealScan 3D laser scanning technology, whose parent company Lockheed Martin was 70-percent shareholder. Twenty-percent partner Intel acquired Lockheed's portion, including Real3D's patents, for an undisclosed sum. Some former staffers are now contracting for Intel. Others, according to insiders, have been hired by ATI Technologies.

Macintosh peripheral manufacturer (and former Mac clone maker) Mactell also folded under its debt load. Mactell was the first announced developer of Mac Voodoo3 cards, but the company's doors closed before a product could slip out. 3dfx has reaffirmed its commitment to the Mac gaming market, but the Mac still suffers from a lack of professional-caliber 3D cards.

Raycer Graphics might have filled that gap, but the company ran short of venture capital on the way to market. Raycer was acquired by Apple in November. An Apple-branded 3D card is not very likely, but Apple can integrate Raycer's employees and technology nonetheless. Raycer held patents on other technology, too, according to MacOSRumors.com, including integrated chipsets and microprocessors for hand-held and other small devices. Such devices play a role in Apple's long-term strategy. Whatever it takes, Apple needs to jack up the number of pixels it can crunch through the pipes to keep up in the workstation market.

Among the companies left standing, the competition is fierce because the market—and profit margin—is tight. ATI was one of few to report some growth in Q4 1999: profits of $32 million (actually $16.8 million after acquiring chip developer Chromatic Research in 1998) on revenues of $304 million. Compared to last year, ATI's revenue is up 49 percent and profit up 10 percent. The company's latest releases are the 32MB All-in-Wonder 128 (bundled with Digital Immersion's Merlin VR software for rapid development of 3D content) and the Rage Mobility 128 for laptops.

ATI also announced its official support for Linux. ATI will release 2D, 3D, and multimedia specifications to the open-source community, plus Linux drivers for 2D and 3D acceleration. It's contracting with Precision Insight of Texas to develop Linux drivers for its Rage 128 technology. Source code is expected to be released in Spring 2000.

(Speaking of Linux, webzine *The Register* reports that the Queen of England's official web site runs Red Hat Linux. The Prince of Wales' site, however, runs under IRIX. Who knew?)

3Dlabs reported Q3 losses of $280,000 on revenues of $13 million, which constituted the company's fourth consecutive quarter of rising revenues and shrinking losses. The new GVX1 and Oxygen VX1 are selling well, plus the company has lined up OEM contracts with lots of PC and workstation vendors: Compaq, HP, Gateway, Dell, and others. That's good progress for a company that last year reinvented itself as a graphics-board business.

Evans & Sutherland has taken hits this year in the workstation graphics business. E&S reported Q3 sales of $48 million, which equals a loss of $1.91 per share after factoring in one-time charges, mostly from its acquisition of Accel-Graphics last year. E&S is still developing 3D technology but pushing more resources toward the simulation market. Its Harmony and simFUSION line of image generators produced more than five times the revenue of its workstation products. (Don't even ask about workstation losses.)

nVidia, also on a roll with lots of gaming and PC OEM contracts, dove into the 3D workstation arena with the announcement of the Quadro, based on its new 256-bit GeForce chip. The move—from windowless game graphics to multi-frame-buffer 3D accelerators—must be related to nVidia's new access to SGI's graphics technology. The workstation market is more complicated but reaps bigger margins. nVidia says Quadro generates up to 17 million triangles per second and fills up to 540 million pixels per second. Quadro-based products will ship with PIII- and Athlon-optimized OpenGL drivers for Windows NT, Windows 2000, and Linux, but unfortunately not Mac. The Quadro will power ELSA's new GLoria II board, and other partnerships include Micron and HP.

3D acceleration in itself is a small, highly competitive market, and it's only getting tougher. To survive, vendors must understand how their technology can be applied to a broad range of products and services, not just chips or cards. If the consumer market fails to generate substantial revenue, the 3D chip manufacturers will need to rely on the professional sector almost exclusively. That's a much smaller pie, and a smaller piece for anyone who remains at the table.

Matthew Hoover is managing editor and news editor for 3D. Email him at mhoover@mfi.com.

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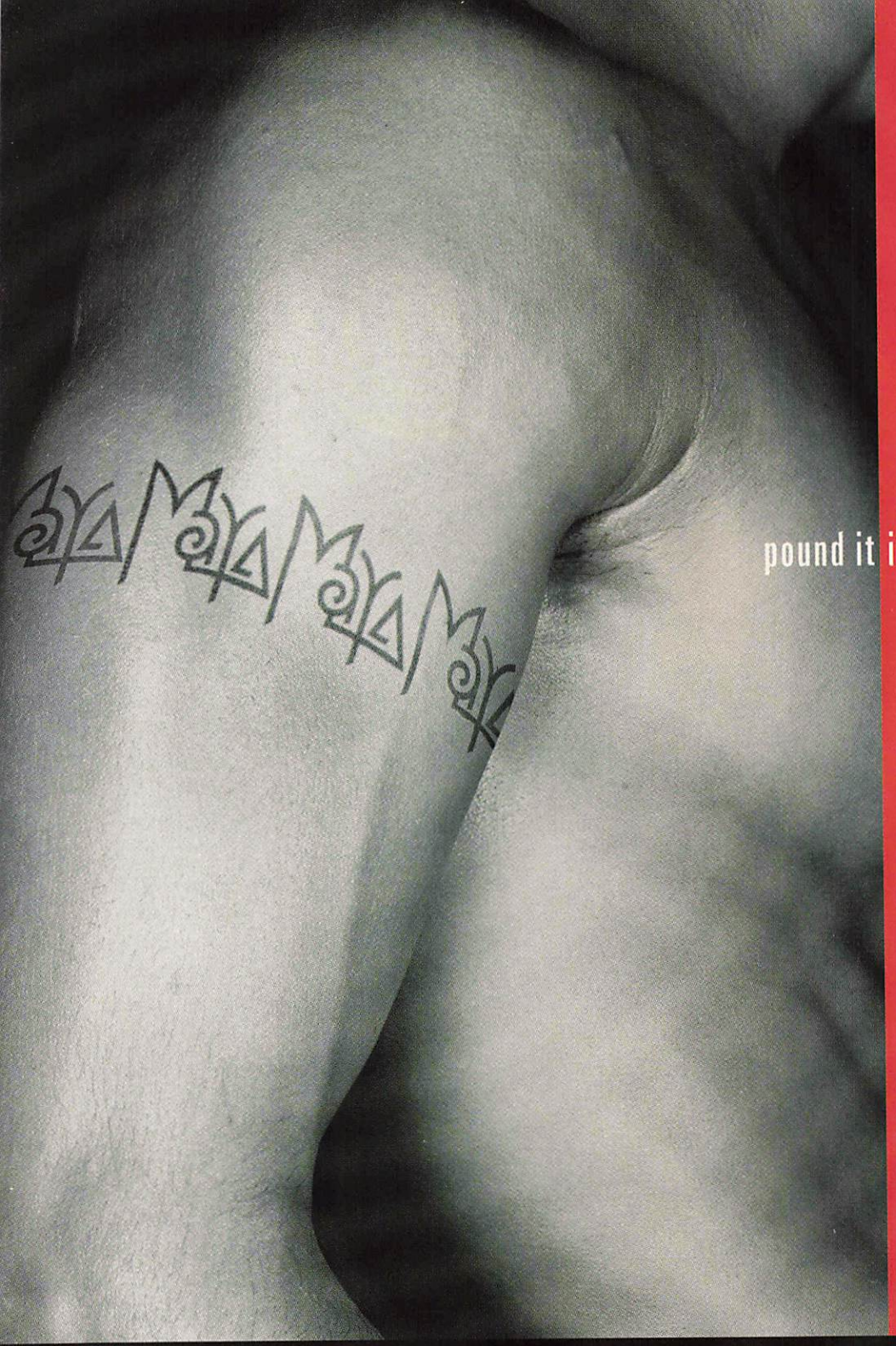

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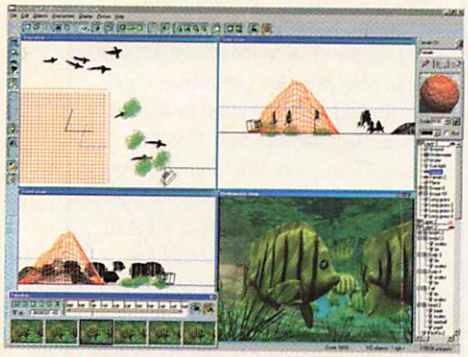


Inspired by the French Countryside

➤ E-on Software, based in Paris, is shipping Vue d'Esprit 3 Mover ($199) for Windows 95/98/NT, 3D software for creating natural scenery. New features include full animation capability including motion blur, improved atmospheres, new vegetation types, and enhanced support for popular 3D packages. Dynamic Motion Reaction technology includes prebuilt motion types (such as helicopter or motorcycle) to get beginners up and animating right away. Vue 3 supports FK, includes video options such as nonsquare pixels, and exports terrains as fully textured LightWave or MAX models. The package includes more than 100 atmospheres, plus a set of animatable ones. www.e-onsoftware.com

Worldwide Rendering

➤ Maxon Computer has announced Cinema 4D Net, a network rendering solution for users of Cinema 4D GO, SE, and XL on Mac, Windows 95/98/NT, and Alpha. Cinema 4D Net ($295 for a three-client license, $495 for 10 clients, or $1,995 for unlimited clients) works over an intranet or the Internet, and since the user interface is HTML-based, any computer with Internet access can control the render. After loading your scene to the Cinema 4D Net server, any number of client computers can be linked together to render the image, and the program dynamically shifts the render load over all clients. Each client has a preview image, and the pool is dynamic—computers can be added to or taken off the job any time. Renders can be controlled from any Internet device: WebTV boxes, Palm Pilots, and, in Europe and Asia, Nokia net-wired cel phones. www.maxoncomputer.com.

Visual, Collaborative 3D

➤ Targeted at architectural, engineering, and construction projects, NavisWorks from LightWork Design is Windows software for visualizing and communicating collaborative 3D designs. NavisWorks ($1,600 single license) can handle million-polygon 3D models in real time, so you can navigate a building plan, for example, and send your view to other team members via the built-in 3D-Mail technology. NavisWorks can read DWG, 3DS, DXF, and DGN (MicroStation) formats, and it can import multiple file types and combine them into one viewable model, which helps multiple contractors, vendors, and designers work on a project. www.lightwork.com

Tools for Interactive Panoramic Movies

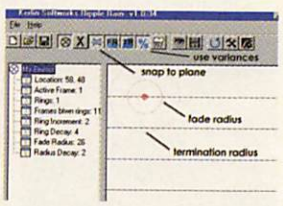
➤ VR Toolbox Inc. announced The VR Worx ($299), a suite of authoring tools for Apple QuickTime VR for Mac and Windows platforms. It integrates three of the company's products into one interface containing three modules. The panorama, object, and scene modules work together to create and edit interactive panoramic QTVR movies. Free demos available at www.vrtoolbox.com.

Bridge from MAX to RenderMan

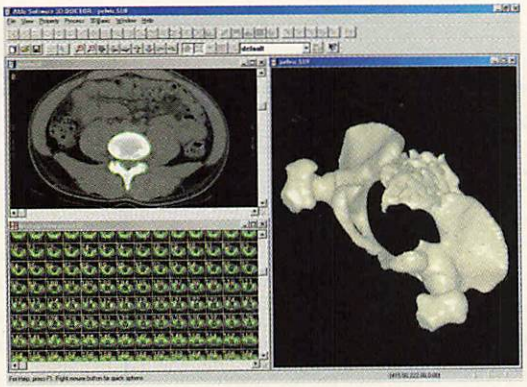
➤ Users of Discreet 3D Studio MAX 2.5 or 3.0 can render their scenes using Pixar's acclaimed RenderMan technology, thanks to MaxMan ($2,000 per license), a new plug-in from Animal Logic. Scheduled to ship Q4 1999, MaxMan provides a top-level interface to PhotoRealistic RenderMan (PRman) or Blue Moon Rendering Tools (BMRT), a RenderMan-compliant renderer. MaxMan produces RIB files, and it supports RenderMan shaders in all contexts, including global atmosphere, light, displacement, and volume, fully integrating into MAX's animation system. MaxMan uses familiar MAX scene controls, supports most native MAX materials, and directly supports MAX geometry types including NURBS, polygons, and quad patches. www.animallogic.com

Making Ripples

➤ Ripple Rain ($99), a new stand-alone app for Windows 95/98/NT from Kerlin Softworks, uses animated textures and bump maps to create rain and impact ripples in water. Ripples are created by defining and placing an emitter in Layout, and adjusting a comprehensive set of parameters (radius, decay rate and duration, variation, etc.). Rain is made from alpha-channeled animated textures parallel and perpendicular to the ripple plane, with guides to aid set-up and keyframing. Frame-by-frame, Ripple Rain figures out where each drop is and creates an impact ripple at appropriate spots. It works with any 3D app that supports animated textures, bump maps, alpha channels, and .tga files. www.kerlinsoftworks.com



Paging Dr. 3D



➤ Able Software has released 3D-Doctor 2.1 ($2,400 per license), a software package for rendering 3D images from 2D medical data—visualizations of MRI and CT scans, for example. With no hardware upgrades, 3D-Doctor can render and output files in DXF, VRML, STL, 3DS, and other formats on Windows 95/98 and NT PCs. You can create vector-based, editable object boundaries from the source images to measure and analyze the 3D anatomical models. Free demo available at www.ablesw.com.

A Faster Driver

➤ 3Dlabs has released PowerThreads SSE, a new OpenGL driver for its Oxygen VX1 accelerator card that's available free of charge. PowerThreads takes advantage of Intel's Streaming SIMD Extensions (SSE) to accelerate geometry-transform and lighting calculations on workstations with single or dual Pentium III or Xeon processors. It also supports 3DNow! optimizations for AMD processors. By working closely with Discreet, 3Dlabs has included enhancements specific to 3D Studio MAX that the company claims provide a performance boost of up to 300 percent. The driver also enhances 3Dlabs cards with hardware geometry acceleration, such as the GVX1 and forthcoming GVX210, by shifting geometry processing to the CPU under heavy workloads. www.3dlabs.com

Still Seamless After All These Years

➤ Marlin Studios announced *Seamless Textures 4: Classic Stonework* ($149), a CD-ROM containing 348 royalty-free tileable textures, complete with bump maps, compatible with PC, Mac, Amiga, and Alpha. The textures, created from photographs of stonework hundreds of years old around Paris and Quebec City, come in three resolutions up to 1152x768. Categories include stone bricks, cobblestones, cut stones, flag stones, ruble stones, and variegated stones. The collection features two bonuses: models of a chateau and castle from Viewpoint Digital, plus 100 color images for reference and inspiration. www.marlinstudios.com

Package Deals

➤ MetaCreations is selling the 3D Suite ($599), a software bundle that includes Poser 4 (character posing and animation), Bryce 4 (landscape modeling), and Canoma (3D scenes from 2D images). The 3D Suite will be available for a limited time for Windows and Mac. www.metacreations.com.

Credo Interactive and Digimation have teamed up to offer the Life Forms 3.5/Bones Pro 2 bundle ($495). Life Forms is a character animation package for Mac or Windows 95/98/NT, and Bones Pro is a skeletal deformation plug-in for 3D Studio MAX 2.0 or higher. www.digimation.com

stray pixels

➤ X Dimension Software has released 3D Exploration ($30), an OpenGL-compliant file viewer for Windows 95/98/NT. It provides an explorer-like interface for viewing files created by 3D Studio MAX, NewTek LightWave, Caligari trueSpace, and Autodesk AutoCAD, as well as Microsoft DirectX, Quake, VRML, and other formats. You can view files as a windowed or full-screen slide show and select a list of favorites. www.xdsoft.com/explorer

➤ Smells Like Almonds ($99) is a new shader package for Cinema 4D, developed by bhodiNUT. The 42 procedural shader engines include attenuated reflections, translucent objects, brushed and tooled metals, and volumetric wood. Each shader has up to 40 parameters. www.bhodinut.com, www.maxoncomputer.com

➤ Puffin Designs announced the Windows version of its Composite Wizard plug-in for Adobe After Effects. Composite Wizard helps artists clean up video composites, such as doing color correction and fixing poor matting from bluescreen shots. $695. www.puffindesigns.com

➤ Pontari Productions has released Super Glow 2.0 ($180), a glow shader plug-in for LightWave 3D on Windows 95/98/NT and Alpha (Mac and SGI versions to follow). New features include unlimited glow layers, a preview window, new glow types including sparkles, and color/brightness-based glows. Glow passes can also be saved as separate .tga files for use in compositing packages. www.pontari.com

➤ Veteran Hollywood effects studio VCE has released "The Visual Effects CD, Volumes I & II" ($249) of royalty-free clips by Peter Kuran, longtime special effects developer. The 35 sequences, shot on motion picture film, range from 720x540 to 2048x1536. Subjects include starfields, explosions, fire, rain, dust/debris, cityscapes, an atomic blast, and more. www.vce.com.

➤ Onyx Computing is shipping TREE Classic 4.3 ($145), formerly TREE Painter, a procedural tree and vegetation creator for Windows 95/98/NT. Version 4.3 can export trees as .bmp or .tga files at various resolutions or as one-poly DXF panels. TREE Classic includes a library of editable trees, palms, and bushes. www.onyxtree.com

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WIRED for 3D

The annual 3D editors' choice awards

If you're as tired of hearing about Y2K as we are, join us for a look back at some of the best products and tools for 3D artists from the past year. 1999 saw many innovations in digital graphics. It was a watershed year, especially in comparison to 1998, which was a bit sluggish from a technological standpoint. We focused on tools, products, and new technologies that help you work smarter, faster, better, or all of the above.

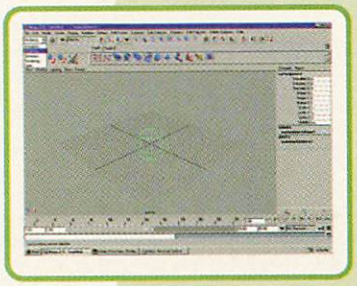
We tried to provide a well-rounded choice of products that impacted professional 3D graphics, as well as the new technologies that have given us a glimpse into the near future of 3D. We look forward to what the new year, and the new millennium, will bring.

SensAble Phantom Desktop

If we gave Wired for 3D awards based on looks alone (and we don't), we'd still have a winner with SensAble Technologies Phantom Desktop modeling system ($10,000 standalone; $14,950 with the FreeForm modeling system). Using a haptic force-feedback pen, this incredibly sexy unit lets you model on your PC while literally "feeling" the model under your pen in real time. It's not cheap, however—this amazing advancement in 3D modeling technology is primarily being enjoyed by folks with deep pockets and bleeding-edge early adopters. We can only hope that some day, a device like the Phantom will be a standard on every 3D professional's desk. www.sensable.com

Alias|Wavefront Maya Unlimited 2.5

Fast becoming the standard against which all other high-end 3D modeling and animation apps are measured, Maya Unlimited 2.5 ($16,000) offers users a fully customizable workspace, a full set of NURBS and polygonal modeling tools, and a character animation system that's more intuitive than ever before. Add to that fur and cloth dynamics, Artisan for natural sculpting, and Paint Effects for painting procedural geometry, and you can see why Maya is truly Wired for 3D. www.aw.sgi.com

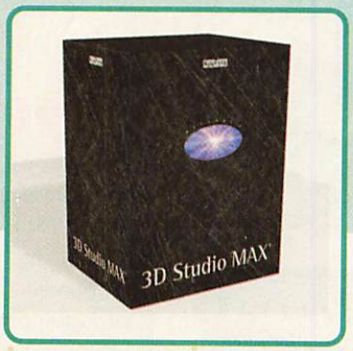


Apple G4, CinemaDisplay, PowerBook 400

Notice how no one calls Apple "struggling" or "beleagured" anymore? With its Velocity Engine PowerPC chip, the Apple G4 (starting at $1,599) has the Wintel folks more than a little nervous. In keeping with the award-winning industrial design of the blue and white G3, the graphite and chrome-colored G4 will spruce up any 3D designer's desktop. With the 22" Cinema Display LCD (available only with purchase of a 450MHz or faster G4, for a total cost of $6,498), you'll have your co-workers turning Bondi Blue with envy. For the ultimate in portable power, you can't beat the G3 PowerBook 400 (starting at $3,499), one of the only laptops that can keep up with just about any desktop out there. Congrats to Apple for being Wired for 3D two years in a row. www.apple.com

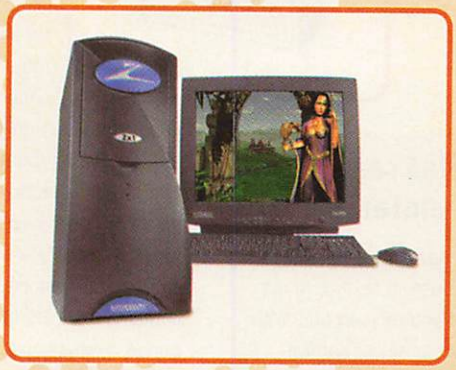
Discreet 3D Studio MAX 3.0

Possibly the most widely used 3D application to date, Discreet 3D Studio MAX ($3,495) has consistently raised the bar on what to expect in a software upgrade. MAX 3.0 sports a completely customizable UI, new rendering features (want to use the LightWave renderer? No problem), slick new modeling and animation tools, and increased performance. Add effect* and paint* to the equation, and you have a set of tools that would have cost $100,000 five years ago. www.discreet.com



Intergraph Zx1 workstation

Once again, Intergraph maintains its competitive lead with a powerhouse workstation, the Zx1 (starting at $3,175, without monitor). With single or dual PIII processors in a stylish black case, the Zx1 offers the best bang for the buck of any high-end workstation. Watch a dual Zx1 with a Fibre Channel RAID pump two streams of HDTV video at 30fps mapped onto 60,000 polygons in a real-time 3D environment. After you stop drooling, you may just get that checkbook out. At least, you'll never look at your old PC the same way again. www.intergraph.com



auto•des•sys form•Z 3.0

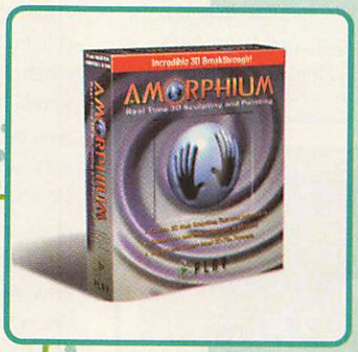
What can't this modeler do? Whether you're making real-time games, designing bridges, rapid prototyping solid-model jet engine parts, or making spaceships for *Star Wars Episode I*, form•Z 3.0 ($2,399) can do the job. All this power comes with a steep learning curve, but once you get the hang of it, the sky's the limit. Export your models in DWG, DXF, EPS, FACT, IGES, Illustrator, LightScape, OBJ, PICT, PNG, QTVR, RIB, SAT, STL, Targa, TIFF, VRML, 3DGF, 3DMF, or 3DS, and your model is good to go in your favorite 3D animation program. www.autodessys.com

Cyra Cyrax 3D laser scanner system

If bigger is better, the folks at Cyra are the ones to beat. The Cyrax 3D laser scanning system is capable of scanning just about anything. From skyscrapers to bridges to full movie sets, Cyrax can generate a topographically accurate mesh, complete with textures. Simply orient the scanner toward the scene, select the desired area and measurement density via your laptop, then auto-scan. Voilà! Instant 3D models of real-world objects. Call (800) 818-2972 for pricing. www.cyra.com

Play Amorphium

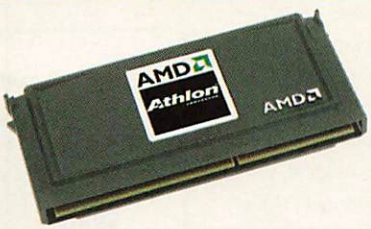
Let's see. There's Artisan for Maya, which used to cost $6,000 and is now part of the $7,500 Maya Complete package. And then there's Play Amorphium ($149), a polygon-based cousin to the NURBS-based Artisan that allows you to model using a push-and-pull methodology similar to traditional sculpting. Any 3D artist doing organic modeling should check this program out. Technology like this was out of reach of most artists' wallets only a year ago. www.play.com



Wired for 3D

AMD Athlon

Once thought of as the 90lb. weakling of CPUs, the AMD Athlon ($209–$849 in 1,000 lots) is an excellent processor with excellent compatibility. Not only that, it has kept Intel on the defensive for the last several months, causing the company to reduce prices and increase speed. We torture-tested this chip and found no application compatibility problems. Already up to 700MHz, the Athlon is powerful, inexpensive, and very stable. Selecting AMD for your CPU is not only a vote for the underdog, it's a worthwhile and cost-effective choice.
www.amd.com

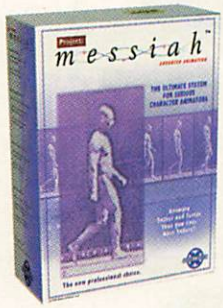


MetaCreations Canoma 1.0

(valiant first try award)

We decided to give a Wired for 3D award to MetaCreations Canoma 1.0 ($499) not because of what it is, but because of what it could be. The idea—using simple primitives to define 3D shapes in photos and extract 3D info and textures automatically—is phenomenal, but the current version needs a lot of help to live up to the concept. We're rooting for this tool and hope the issues raised by version 1.0 will be properly addressed in version 2.0.
www.metacreations.com

Station X Studios Project: messiah



If you want it done right, do it yourself. That's the attitude at Station X Studios, a LightWave-based production company in central California. When they needed to extend LightWave's character animation tools, they coded the improvements, and now they're offering them to everyone. Running stand-alone or as a LightWave plug-in, Project: messiah ($995) is a top-notch character animation tool. It contains a full FK/IK system, bones, expressions, simplified character setup, real-time interactivity, procedural keyframe animation blending, and much more. Truly Wired for 3D—characters, that is.
www.stationxstudios.com

Right Hemisphere Deep Paint 3D

It's finally here: true real-time 3D painting on models. Once confined to high-end SGI IRIX machines, 3D paint has been a long time coming to PCs. Many tried, but they all failed to deliver a usable product. Right Hemisphere got it right, and Deep Paint 3D ($795) is a very capable 3D paint tool. It also lets you model with paint tools by physically deforming a surface to change its geometry. It operates as a Photoshop plug-in; interfaces directly with MAX, Softimage, or Maya; and transfers your models among a wide variety of file formats. Pretty deep, and pretty Wired for 3D.
www.righthemisphere.com

MetaCreations Painter 6.0

If you've never tried Painter for creating custom texture maps, boy, have you missed out. With the broadest set of natural-media painting tools anywhere, Painter 6.0 ($399) continues the tradition of enhancing what could be the best paint package in the world. Painter 6.0 adds better file handling for large images, brush loading for multi-colored brushes, Impasto paint, a better image hose with hundreds of nozzles, better text controls, and more, making it a must-have for anyone creating custom textures or 2D artwork. If you add a Wacom tablet, you can take advantage of pressure, tilt, bearing, and direction to make your brushes feel like the real thing.
www.metacreations.com

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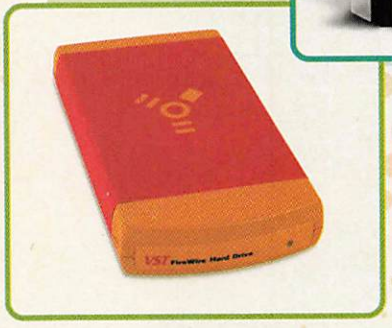
WIRED for 3D

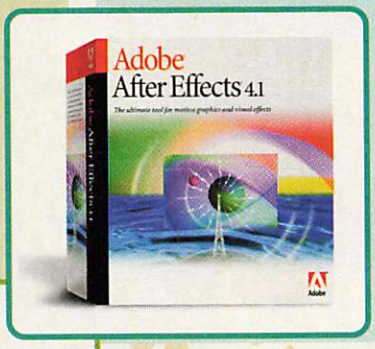
VST Technologies FireWire hard drives

There is definitely a cool factor to these little red devils. VST FireWire hard disks ($379–$999) come in 4, 6, 8, 10, and 14GB configurations, are very portable, have data transfer rates up to 400Mbps, and allow for hot-swappable, plug-and-play, portable storage. Just plug this puppy into a FireWire-equipped Mac or PC, and wherever you are, that's where your data will be.
www.vsttech.com



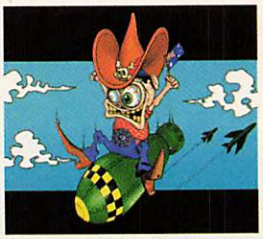
Adobe After Effects 4.1

Don't be fooled by its ".1". After Effects 4.1 ($689, $1,499 production bundle) provides a much-needed feature for 3D artists: the ability to import images with Z-depth information in Discreet RLA, Softimage PCI/ZPIC, and Electric Image EI/EIZ file formats. With the ID matte feature, objects can have separate material IDs, and effects like depth-of-field and 3D fog can be added in post.
www.adobe.com



Illustrate! 4.0 for 3D Studio MAX

The web is going Flash in a big way. Just recently, though, people have started to figure out how to add 3D to their Flash animations. Illustrate! 4.0 ($395) for 3D Studio MAX is one method. Using a cel-shader rendering engine and vector export control, entire MAX scenes can be "Flashed" and viewed in 2D by more than 85 percent of today's web browsers. VRML may be dead on the vine, but Macromedia has a chance to steal the 3D show using Flash as the delivery mechanism. With tools like Illustrate! 4.0, great 3D on the web may be right around the corner.
www.davidgould.com,
www.digimation.com,
www.macromedia.com



Red Hat Linux 6.1

Why Linux, and why the Red Hat version ($29– $79)? Linux has made serious advances as the OS of choice in many production facilities and render farms. Most high-end 3D software companies offer (or have announced) rendering support for Linux, and some are porting entire apps to the open-source OS. However, while open source is a boon, companies such as Red Hat further the cause and help obtain mainstream computer graphics hardware and software support for Linux—the fledgling David to Microsoft's Goliath.
www.redhat.com

Digital Origin MotoDV Mobile for PowerBook

If having the best laptop two years ago was the ultimate in portable geek chic, this year it's gotta be video on the go. Digital Origin has taken its popular EditDV and MotoDV software and bundled it with a PCMCIA FireWire card ($499 bundled). With the addition of a 1394 digital video camera and a G3 PowerBook, you'll have every director in Hollywood looking over your shoulder. If you ever have to "get away" but need to take an entire video editing facility with you, this is definitely the way to go. Add After Effects or Final Cut Pro, and you can keep up with the best of them.
www.digitalorigin.com

Pixologic Z-Brush
(promising beta award)

Using 3D forms and drawing tools, Z-Brush allows you to paint three-dimensionally, all the while ultimately creating a 2D image with shadows, highlights, and much more. Still in beta, this tool promises great things, and we encourage everyone to download it and check it out. It's the freshest concept to come along in quite a while.
www.pixologic.com

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by Chris Tome

Twice Upon a Time

Pixar Makes History All Over Again

In late 1995, a small digital graphics studio in the San Francisco Bay Area made history. *Toy Story*, the humble tale of a cowboy doll and his playroom cohorts, became the first feature film created entirely out of ones and zeroes, and Pixar Animation Studios, a boutique partner of Disney's, became the undisputed pacesetter in digital artistry. The movie, directed by CG pioneer John Lasseter, went on to become one of the most successful animated films of all time. Cowboy Woody and his astronaut sidekick Buzz Lightyear became household names virtually overnight.

When it came time to think about making a sequel, the higher-ups at Disney thought they had it sown up. After all, one of the great benefits of digital production is that once you've created the assets, you can use them again and again free of charge, reanimating and

rerendering the models as many times as you want. To *Toy Story* Infinity and beyond!

The suits had another thing coming. During the intervening years, Pixar had poured its steadily advancing technology and experience into *A Bug's Life*, a second all-CG feature presentation whose imagery was a quantum jump beyond that of its predecessor. "They thought, 'We can approach the whole planning of the sequel as if it were *Toy Story*," recalls Galyn Susman, supervising technical director. "I said, 'We're coming out a year after *A Bug's Life*. That's not going to be good enough.'"

After endless rounds of meetings, Susman's point of view prevailed. When production began in earnest in early 1997, the central challenge became incorporating new technology and techniques while maintaining the look and feel of the original movie. As one artist involved in the project observed, "Inevitably we've gotten better at what we do, but on the other hand, we didn't want to create a completely different world no one would recognize."

Today audiences the world over are revisiting Woody's world and seeing it anew. Once again directed by Lasseter, *Toy Story 2* presents a rich CG universe with believable characters, detailed textures, exquisite lighting, and stunning camerawork. All the original characters are back, along with original star voice talent such as Don Rickles and Tom Hanks. In addition, Pixar concocted a gaggle of new ones, among them Woody's trusty steed Bullseye; Al, a portly vendor of used toys; Wheezy, a rubber squeeze-toy penguin; and Jesse, a saucy cowgirl doll and love interest for Woody.

As described by coproducers Helene Plotkin and Karen Robert Jackson during the final stages of production, the story begins when, during a bit of roughhousing with young Andy, Woody's arm becomes torn. The damage relegates him to a dusty shelf with other broken toys such as Wheezy, whose squeaker emits only a dull wheeze. Bad turns to worse when the injured cowboy finds himself in a yard sale and becomes property of Al, who sells used toys to collectors - collectible status being the kiss of death for any playful toy. To his surprise, Woody learns that he is part of a designer collection, the other members of which he comes to recognize as his real family. A daring rescue brings the film to a fitting climax.

Toy Story 2's thematic underpinnings of mortality and belonging probe emotional territory rarely occupied by animation. Charting it was the work of Dan Jeup, who served as story supervisor. Storyboards created by Jeup and his team were assembled into animatics by layout supervisors Rikki Cleland-Hura and Ewan Johnson, who determined the role of shot composition and camera motion in telling the story. Meanwhile, associate technical director Larry Aupperle worked on modeling and rendering techniques, and directing animator Dylan Brown and his team brought it all to life. Then shading supervisor Brad West upgraded old textures and created new ones with help from associate technical director Oren Jacob and numerous others.

Tell Me a Story The halls of Pixar's main building are named like streets; walking from one office to another, you pass Rue de Pixar and NURBS Lane. The corridor walls, each painted in a different color, give the hallway a kaleidoscopic effect. They're covered with production artwork, including mattes and storyboards for *A Bug's Life* and other productions.

Even this feast for the eye pales compared to the Story Room. The walls surrounding this sizeable office are covered with bulletin boards to which are pinned a patchwork of storyboard panels. In the middle sits a cluster of drawing tables stocked with pans, a paper cutter, and a Barbie doll. A stroll around the

Woody, Jessie, and Bullseye the pony take a spin.

Artist photos by Kelvin Jones, except Ewan & Rikki by John Poppelwell

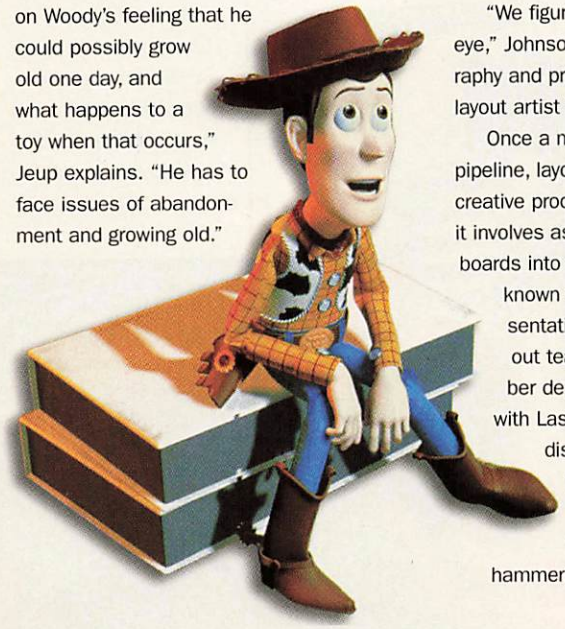
room's perimeter serves as a self-paced guided tour of *Toy Story 2*, and that's roughly how it functions for the artists, animators, and technicians throughout production.

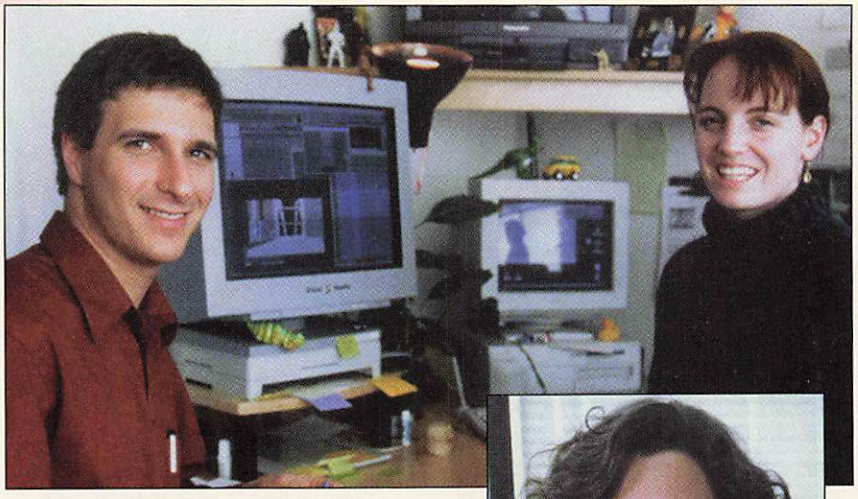
When Dan Jeup first joined the project as story supervisor, the basic idea for the movie was in place, but not much else. A graduate of California Institute of the Arts, Jeup spent six years at Disney in various departments before being offered a position at Pixar by Joe Ranft, head of story for the original *Toy Story*.

Jeup's first task was to critique Lasseter's initial ideas. He wasn't alone in this role; all members of the story team contributed, pitching in ideas about story structure, defining characters, acting out scenarios, and so on. Ideas were revisited time and time again, refined until everyone was satisfied. The team averaged five members, but as the schedule grew more urgent, it swelled to 22. Fortunately, some among them had worked on the first movie, helping achieve the necessary continuity.

During his years at Disney, Jeup gained a keen appreciation of traditional story structure. "In any movie, story, or play, the main protagonist has some kind of problem, and he or she (or it) needs to overcome it," he explains. "As you go through the structure of the film, he faces obstacles and overcomes them, and he changes as a result. By the end of the movie, he overcomes his problem, and you wrap it all up with a happy ending. It comes down to what you're ultimately trying to say with that character."

What was the story team trying to say with Woody? "The film touches on Woody's feeling that he could possibly grow old one day, and what happens to a toy when that occurs," Jeup explains. "He has to face issues of abandonment and growing old."





Above: Ewan Johnson (left) and Rikki Cleland-Hura, layout supervisors. Right: Galyn Susman, supervising technical director.

One set of storyboards on the wall depicts the sequence in which Woody is put on the dusty shelf and meets Wheezy. While many of the boards were collaborative efforts, these were Jeup's own. It's rare to own a sequence, though. Almost every artist works on almost every sequence in the end. If a better idea comes along, it sticks. As Jeup puts it, "You kill your babies and move on."

Assembling Animatics The *Toy Story 2* storyboards moved on as well, landing on the desktops of layout supervisors Rikki Cleland-Hura and Ewan Johnson. "Layout is where the shots begin to exist," Cleland-Hura explains. "This is the first time a director sees the world that they've dreamed up." Her background is in computer engineering and game development. She came to Pixar in 1996 as a lead engineer on the product design team in the now-defunct interactive division.

"We figure out how to direct the viewer's eye," Johnson adds. Having studied photography and printmaking, he joined Pixar as a layout artist for *Toy Story* in 1994.

Once a minor step in the production pipeline, layout has flourished into a critical creative process at Pixar. In practical terms, it involves assembling the digitized storyboards into story reels, more commonly known as animatics, a moving representation of the still sketches. The layout team, which varied widely in number depending on the workload, met with Lasseter and the other directors to discuss each sequence in detail, including the overall goal, sets, blocking, and so on. Then they tackled each shot one by one, hammering out the details and delivering all the variations that were requested, along with a few of their own.

Once they were approved, the story reels were sent to the editorial department, where they were sequenced and dubbed with dialog and music to produce a mockup of the final product. Since the actual voiceovers frequently didn't match the timing of scratch tracks used during layout, this turned out to be a creative process as well. Editorial sent some shots back to be reworked, and they edited others extensively before the animatics were finished.

"In addition to that," Cleland-Hura adds, "because we're a computer animation studio, we set up all the shots as files. We get everything ready for the animators, putting the characters where they should be and adding the visual cues they need to understand what needs to happen in each shot." For example, for a shot in which Woody walked across a room, the layout team provided a file in which Woody slid from position to position, the first step in animation blocking.

Animatics and animation setup notwithstanding, the layout team's most apparent contribution to *Toy Story 2* was camera motion. The storyboards, Cleland-Hura points out, focused on conveying plot and emotion. "Our focus," she says, "was storytelling through the camera."

"It's akin to a live-action metaphor," Johnson continues. "You figure out what story you want to tell, then you design the shots you're going to use to tell it." He describes a scene in *The Silence of the Lambs* in which the psychiatrist Dr. Chilton inspects villain

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Hannibal Lechter's room. "He's walking around and Hannibal is tied up and he has the mask on. Then Chilton looks at the bed and you see the pen. The camera cuts back to Hannibal, cuts back to the pen, and that's it—you know the pen is going to play a role in the story. This was not acting. This was just the camera."

One of the luxuries of using a virtual camera is the opportunity to execute moves no real-world camera could make, but this is discouraged at Pixar. "Our general philosophy is to use motion that feels like it could happen with a real-world camera," he explains. "Nonrealistic camera motion can really ruin a story for people. It makes them look at the movie instead of paying attention to the characters. But occasionally we'll resort to it to push home a point."

What if the point fails to get across? "There were times when what we thought would work didn't work at all," Cleland-Hura admits, "Then we'd hammer it out by trial and error, or by shooting a lot of coverage and giving it to editorial to see what they could come up with."

Nonetheless, she takes special pride in the subtlety of camera motion in *Toy Story 2*. "I think we did more in this film than we have in the past," she says. "We've got this really hard, fast, dynamic action stuff, and then we have beautiful slow moments. We did it all in one film, and we did it supporting the story."

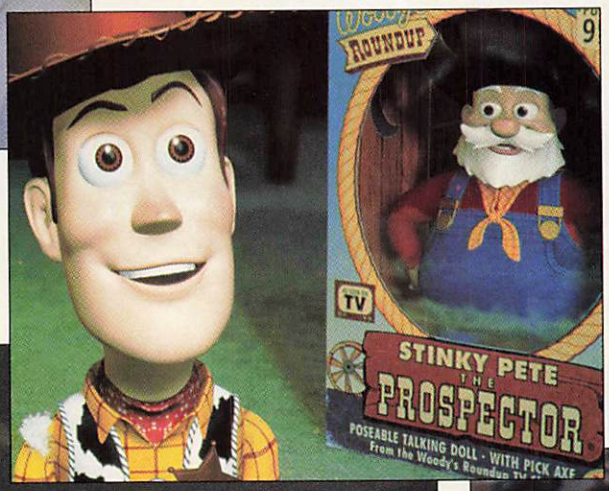
Character Design While Cleland-Hura, Johnson, and the rest of the layout team were piecing together the narrative, the modelers were busily assembling the cast. It seemed simple enough to reuse the original character models, so they assembled the new characters first.

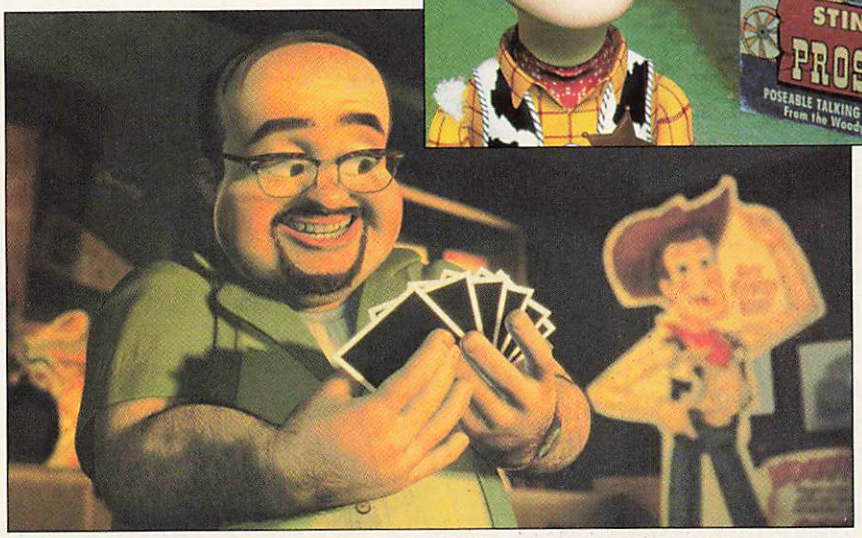
"The new characters looked fantastic," Susman recalls. "Then we looked at Woody, and he looked like old technology."

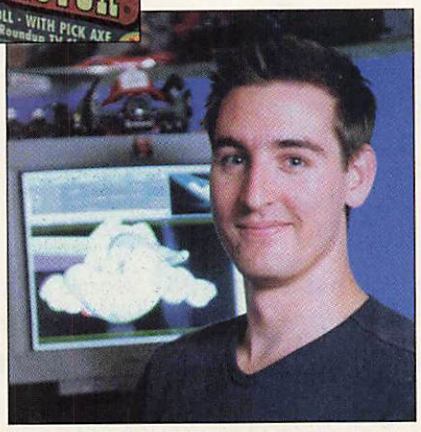
The difference became apparent with the completion of Stinky Pete the Prospector, one of the toys in Woody's designer collection. According to Larry Aupperle, associate technical director and self-described "third banana to the technical director," the cloth of Pete's shirt was rendered in such detail that Woody's clothing looked artificial in comparison. "We had to update Woody to a level that would be acceptable with the new stuff," he says, "but we couldn't go so far that people would think Woody's clothes had changed."

Aupperle's specialty is secondary motion. "Someone else will make a pant leg," he says, sitting in a small office festooned with cowboy lariats. "But what I'm interested in is how the pant leg folds up on itself." His goal was not physical accuracy, but the appearance of physical accuracy. "In many cases," he observes, "physical accuracy is not art-directable, and it just doesn't look right." Aupperle was bitten by the CG bug while attending his first SIGGRAPH meeting in 1989 as a Ph.D. candidate at Princeton; immediately he set about writing his own ray-tracer. He joined Pixar's commercial division five years ago just as *Toy Story* was entering the final stages of production.

The process of designing Al, over which he presided, was typical of Pixar's general approach to creative work. First the art department came up with sketches. Then Aupperle and his team watched footage of overweight people, paying special attention to secondary motion of jowls and the like. It was decided that Al would be more portly than fat, so they slimmed him down a bit based on photographs of Pixar's heavier employees. "We had to make it clear we weren't trying to insult them," Aupperle shrugs. Al's beard and balding head benefited from dramatic advances in hair rendering. "That's something we had lots of problems with in the original *Toy Story*," Aupperle recalls. The new technology, he says, is " basically a lot of little hairs. The cleverness is in being able to distribute them on a surface







Associate technical director Larry Aupperle (above) and directing animator Dylan Brown (far right). Big Al (bottom) is excited about his hand, and Woody (right) is wide-eyed next to Stinky Pete.

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where they're artistically desired and keeping them so you can render in a reasonable amount of time. The rest," he adds, "was sweat."

Al's form made intensive use of subdivision surfaces, a Pixar technology that smoothes objects interactively and allows for adaptive level of detail (LOD). In fact, everything except his watch and glasses were built of subdiv surfaces. "We throttled back a bit on the dynamic nature of it," Aupperle says, in comparison with *Geri's Game*, a short film in which the technology made its debut, "simply because it's a matter of control."

The characters in *Toy Story 2* had many more control handles, or avars (animation variables), than their predecessors. Al, for example, had four avars just to control the movement of one eyebrow. But additional avars were only part of the difference. Equally important was the fact that they were organized in a more hierarchical fashion, which made the characters easier to control. "As an animator," Aupperle remarks, "you shouldn't need to know how it works—just that it does."

Unconstrained Motion The heart of Pixar is an area known as the Pit. The Pit looks like a cross between a corporate cubeland and an amusement park—the closest thing to the back lot, perhaps, in a studio where the sets reside in computers. A circus big top hangs overhead. Some cubicles are outfitted with castle walls built of styrofoam bricks, others with rattan roofs and potted palm trees. Inside the cubicles themselves, shelves packed with action figures complement SGI Octanes and Indigo 2 Extremes.

From his lair in the Pit, directing animator Dylan Brown oversaw *Toy Story 2*'s animation. Although he animated some shots, most of the job was managing the animation effort as a whole and putting out fires. His behind-the-scenes responsibilities included testing models and animation chains and making sure the animators got what they needed from the layout department.

Brown became obsessed with computer graphics while he was in college in the late 1980s. "I got all the information I could, which was pretty sparse at the time. Then I discovered Dennis Muren and said, 'I want to do what that guy does!'" Roughly a year and a half into San Francisco State's computer animation program, he signed on for an internship in Pixar's interactive division, from which he was plucked for a 10-week intensive training program in animation. Since then, Brown's education has been on the job, animating the bird in *A Bug's Life* and the "outtake" in which Flik stands on a dandelion and proclaims, "To infinity and beyond!"

The models for *Toy Story 2*, he says, were fairly lean and straightforward in comparison with those for *A Bug's Life*, which were much more complex due to the vagaries of insect anatomy. All the models from the first movie were converted into subdiv surfaces. "They didn't look any different," Brown observes, "but you can do a little more with them."

"It's a challenge to rework an established character," he continues. "Suddenly, you're able to rethink the controls. You have to decide how much of that to do and how much of the original structure to preserve, because you don't want the character to change in appearance and motion. It has to remain true to the original, so the audience has a sense of familiarity."

Generally, layout delivers simple animations that block out the scenes, which Brown modifies as needed. To view his work, he dumps frames to a Windows machine dubbed the Bandit that plays them back at full frame rate. Most shots arrive with the cameras locked off. Moving them

inside the toy chest: a peek at pixar's proprietary tools

One of the advantages of working at a large animation house like Pixar is access to tools tailor-made by staff programmers. Although off-the-shelf applications such as Adobe Photoshop, Amazon, Alias Studio, and Maya Unlimited are used, the core of Pixar's tool kit is a 3D animation package called Marionette.

Running on IRIX, Marionette encompasses virtually all animation functions. "The core system was designed by an animator for animators," Galyn Susman explains. "It allows us to bring in animators with little or no computer experience, and in a short period of time, they can use the system."

Marionette follows a traditional exposure-sheet paradigm. "You have control over every single moveable piece of a character in a timeline," Susman says, "every knuckle or whatever. You attach one hand to the other hand, and when you pull one, the other comes along for free."

Asked to compare Marionette to off-the-shelf 3D animation tools, Oren Jacob recalls an experience he had while teaching Softimage. "One day, a student said he wanted to make his character's belly jiggle when the hips move back and forth. In Softimage, you'd add an IK chain from the spine to the center of the belly button and maybe use a deformation lattice on the belly, but it's very difficult to connect that to the hip controls. In Marionette, you'd just add an avar (animation variable) to the character's belly. The entire model is linked with custom expressions, allowing the animators total control over how one part of a character influences another part."

Marionette disguises expressions as control handles, or avars, for the pieces of a character. "The other things you want to have happen just occur in the model," Jacob continues. "You can direct all the controls into a single important control, which is all you want to get your hands on."

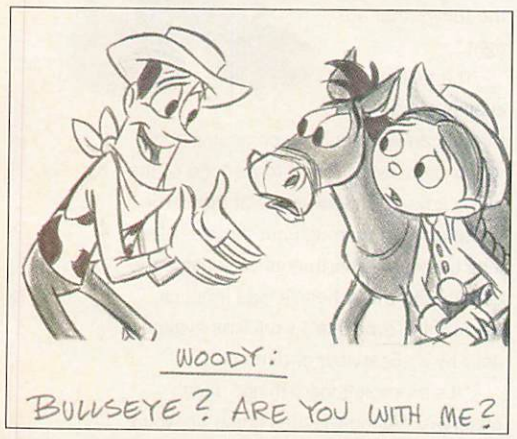
"You don't have to be a programmer, either," Susman adds. "We have articulation tools that allow you to sweep out points and say, 'I want to control these points with this avar, and this is what I want them to do.' You can weight them to respond to the avar in a particular way. But it all looks like a general interactive user interface in any program."

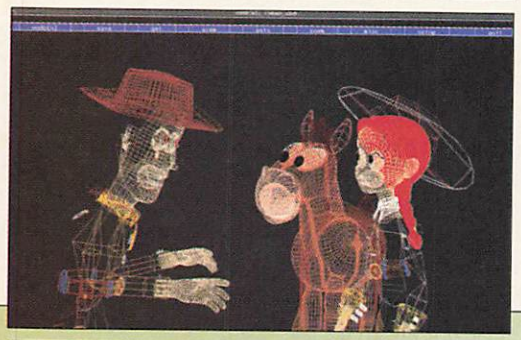
Marionette's output is an executable program that's ready for the next stage of the production pipeline. "You run a script and it compiles everything and puts it into a real program that can be executed," Susman explains. "Once you've got that thing as code, a programmer can take it and write scripts for more functionality."

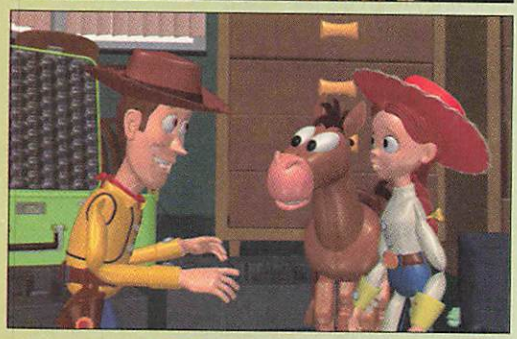
Dylan Brown sits down at his 300MHz SGI Octane to give a demo. At first glance, Marionette looks a lot like other IRIX applications. The GUI includes a control window, a camera window, and a perspective window. There are also function curve editors and a

isn't common, but the animators do have the ability to change camera placement if they feel it's necessary.

"When a shot comes to me," Brown explains, "it has been in story for a year or two, and in layout for at least two months. It has received a tremendous amount of thought, review, and scrutiny before it even hits my desk."







The progression of one shot (from top): storyboard, wireframe, smooth-shaded, and final render.

Problem solving is where Brown feels he had his biggest impact on *Toy Story 2*. One case involved the troll doll, which needed to nod her head to indicate yes and shake her head to say no. Unfortunately, her neck wasn't articulated for motion. Brown's solution was to build a separate model of the head with the necessary articulation and swap it in at render time when necessary.

I refer to this as a hack. "Exactly!" Brown replies. "People use the word cheat, but when you think about it, everything in CG is a cheat. You're faking things like gravity, contact, and all that. The only thing that matters is how the 2D image looks," Brown concludes. "It doesn't matter how you got there."

Painting Surfaces The final look of the 2D image was the responsibility of shading supervisor Brad West. Working with RenderMan, the renderer developed by Pixar and renowned as the best available for movie work, West and his team evaluated the texturing of the original characters one by one. In many cases, they retained the shaders and revised only the lighting. The sets, however, were another matter. "A lot more detail and experience shows through in the new environments," he observes.

Although West and his team used the same version of RenderMan that's available for sale, all the shaders were custom-coded, some by West's own hand. He had written his first shader as a student at the University of Washington. The University has close ties with Pixar, and after he graduated he attended Pixar University—onsite training for interns and new hires about being technical directors—where he learned the studio's production techniques and eventually landed a job.

RenderMan accommodates two main types of shader: bitmap and procedural. To conserve processor cycles—especially at render time—anything that can be done procedurally is. "We always try to make the choice that will get us where we need to go as fast as possible," West observes.

Even when a bitmap shader was used, a procedural component usually was layered on top of it. A bitmap looks like a bitmap, and a procedural map looks procedural. Mixing the two is the best way to get a believable surface.

Human characters such as Al presented spreadsheet-style window that holds all of the character controls and keyframes for the current scene. Hotkeys toggle between them.

The spreadsheet's rows represent avars and the columns represent keyframes. Each cell contains the value of a given avar at a given keyframe. If you click on a cell and drag left or right, the number increases or decreases. Alternatively, you can move parts of a character in the perspective window. "I tend to block stuff out in the spreadsheet," Brown explains. "Then I go into the spline editor, where I actually animate."

Brown loads a Buzz Lightyear model. The head alone offers roughly 35 avars. "Including fingers, little facial stuff, and all that," Brown says, "you probably have to animate 300 avars for a shot, depending on the character. The challenge is knowing the right things to move and how to be efficient."

Surprisingly, Marionette doesn't typically use motion constraints. Brown pulls the avar that controls Buzz Lightyear's smile. As he pulls it to an extreme, the smile breaks.

Brown works in camera mode, which offers a low-res, Gouraud-shaded preview. Adaptive level of detail is inherent in the models, so he doesn't have to swap between low- and high-res versions while he's working. When he's ready to go home, he sends the shots to the render farm, which renders film-resolution frames.

Perhaps the best aspect of Marionette is the ability to request the features and alterations you need. If the animators run into a problem, the technical people code a fix quickly. "Improvements are being made constantly," Brown explains. "You'll hear somebody say, 'It would be great if it did this,' and you're like, 'Wow! I can't believe I never thought of that.'"

At the top of Brown's wish list is a real-time preview complete with shadows, motion blur, and all the other details that show up in a final render. Although he believes it will come in time, "I think it will never be fast enough," he adds. "If you can think and it takes a half second for your thought to appear onscreen, it's still not going to be fast enough."

the greatest challenge, and West worked closely with texture painters to achieve the stylized yet realistic look they were aiming for. "The painters looked at real skin," West explains. "Then they painted facial details such as blemishes, scars, and so on. Once we added things like procedural stubble, the combination looked very real."

In RenderMan, a light is just another shader. In fact, only one light shader is available, "but with a billion controls," many of which were added during the making of *A Bug's Life*. Some scenes look as though they utilized radiosity, but RenderMan doesn't do radiosity or even raytracing. Instead, the effect was created using environment maps. "If you have, say, reflective metal," West explains, "it will look like metal, but it's not nearly as processor-intensive as raycasting accurately."

Asked about the configuration of the Octane sitting under his desk, West had no idea. "We care more about the render farm," West said, "and I don't even know the stats on that. A lot of what we do here is write code using a text editor. As long as that works, I'm happy."

Rendering Challenges Even when everything works properly, the results aren't always as they were envisioned. When that happens, a production heads into the uncharted territory of trial and error. *Toy Story 2* had its share of such moments. One occurred during the rendering of the scene in which Woody meets Wheezy the broken squeeze-toy penguin on the dusty shelf where Andy's mother puts broken toys.

The shelf is a place that doesn't get much attention, and the dust has built up into a thick layer. Associate technical director Oren Jacob test-rendered the scene using dust algorithms cooked up by Pixar's technical crew. Unfortunately, it didn't look quite right. "John wasn't quite happy with the way it was going," recalls Jacob, who joined Pixar as an intern nine years ago while he was a student at the University of California's Berkeley campus. "I didn't know what to do about it."

The dust rendering software involved a RenderMan technique known as dynamically shared objects. In this case, the objects were minute hair primitives, the same ones used to make Al's beard. The hair primitives were mapped to spheres controlled by a particle system, but instead of drawing each sphere, the renderer substituted a number of hair primitives.

Jacob tried rendering with larger particles and particles of different characteristics, but nothing seem to improve the result. "Finally," he recalls, "somebody said, 'Why don't we use, like, 100 times the number of pieces of dust and see what happens?'

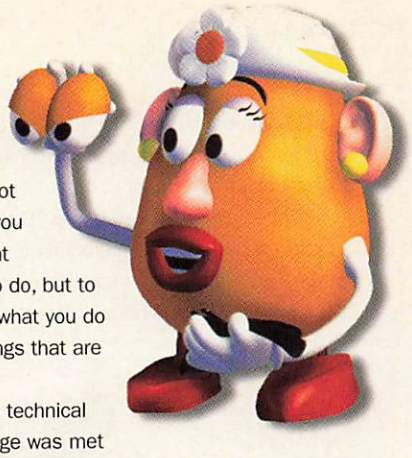
They went back to the computer and added more dust. First they rendered 10,000 particles, but it didn't make much of a difference. They bumped the number up to 100,000, and things seemed to improve. So they tried 500,000, then two million, then four million dust particles.

"We kept going until we found the look we wanted," Jacobs says. "It wound up being 2.4 million particles total. We spent a week figuring out how to do it, and in the end, it was just more of the same. It was a simple solution, but it took a week of very strained thinking."

For Jacob, this experience encapsulates both the best and the worst aspects of working on *Toy Story 2*. "When you try and don't get it right, and you're not seeing what the director is seeing, that's the worst part," he says. "When you go back and get it right, that's the best."

Life in a Playground In the broadest perspective, the challenge of making an all-CG feature film is twofold. One aspect is creative: imagining and creating every detail of a world. The other is technical: organizing a production pipeline in which, unlike a live-action production, changes can be made at every stage at any time.

The key to the creative challenge is in the hands of the director. Lasseter dealt with it by distributing responsibility throughout the entire team. As Rikki Cleland-Hura puts it, "John's philosophy as a director is that he's there not to tell you the right thing to do, but to find in what you do the things that are right."

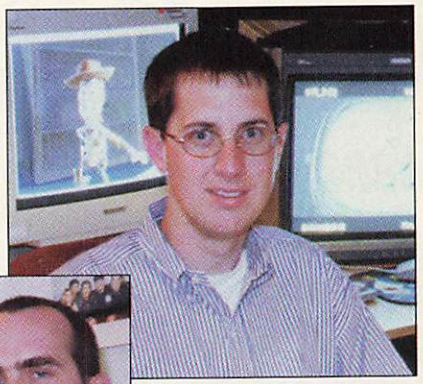


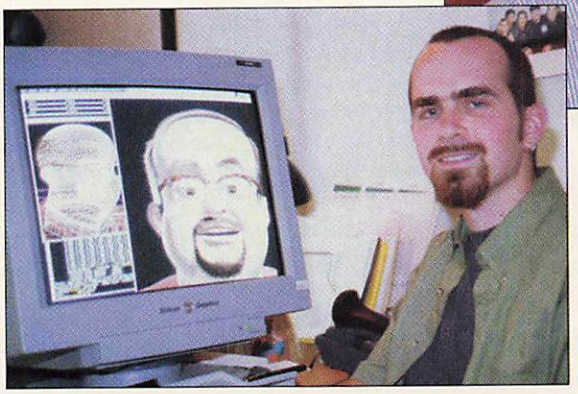
The technical challenge was met through an emphasis on communication, which Oren Jacob refers to as "one of the prime keys and motivators" at Pixar. The approach was thorough but flexible. Meetings between departments took place frequently, but the schedule was irregular. Meanwhile, everyone's work was evaluated daily by a supervisor or director.

"It's an evolutionary thing," Jacob observes. "As new issues come up, you devise new systems to deal with them. There's never one way or one production hierarchy. It changes constantly."

What makes Pixar unique? "Everything!" Dan Jeup pipes up without a moment's hesitation. "It's like the original Disney studio. There's great art and great technology, and a need to make great movies. Also, there's a priority not to put the technology over the story. Story is everything. If you don't have that, everything else falls apart."

Chris Tome is technical editor for *3D*. Email him at ctome@mfi.com.





Above: Associate technical director Oren Jacob.

Left: Shading supervisor Brad West (no relation to Big Al).

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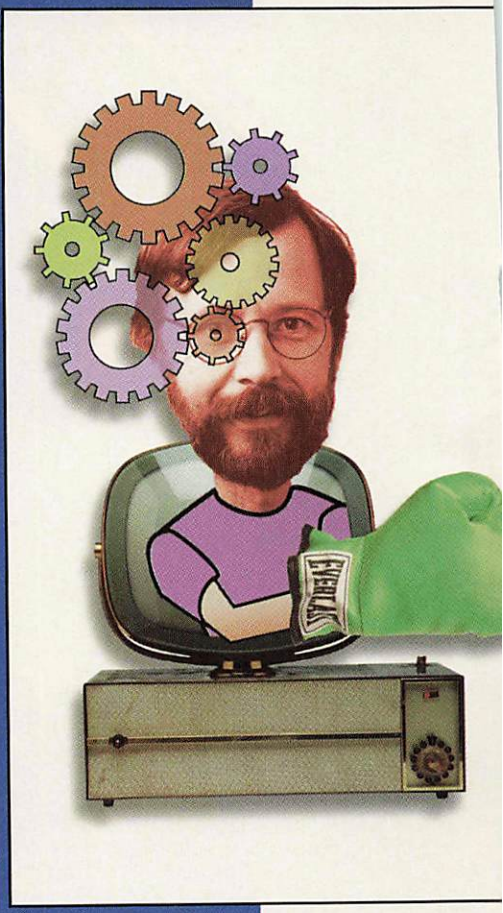


Never ask an expert what's going to happen in the future. Everyone who really knows what they're talking about knows that the future is too complex to anticipate, and anyone whose reputation rests on expertise is smart enough not to risk it by making predictions that don't come true. The only people you can depend on for a forecast are marketing executives who have a vested interest in the scenarios they describe.

On the other hand, the turn of the millennium is the kind of event that prompts virtually everyone to reflect on the state of the present and its implications for the future. You can bet that even the most cautious authorities are thinking about what will happen next. It's just a matter of getting them to talk about it.

So we threw our own advice to the wind and dared to ask. We scanned the digital graphics industry for people whose vision has led to extraordinary creative, technological, or business success, people whose insights might provide a clue to the shape of things to come. We asked them for a preview of the future through their own eyes, as well an evaluation of 3D graphics here and now.

At the top of our list was Pixar cofounder Ed Catmull. Catmull was instrumental in creating the first digital effect to appear in a feature film (*West World*, 1974) and hasn't stopped since. His first "big idea," he says, was to make an all-CG feature film. His second was to build a digital studio. Having realized the first two, he's at work on the third: to make a story with the staying power of Homer's *Odyssey*.

Jim Blinn's involvement in computer graphics goes back just as far. His career has led from developing technology at the University of Utah to animating for Carl Sagan's PBS television series *Cosmos* and back to R&D at Microsoft, where he currently serves as Graphics Fellow.

Following in Catmull's and Blinn's tracks, John Dykstra, Ron Thornton, and Phil Tippett were among the second wave of CG explorers. Dykstra brought a background in photography and industrial design to his pioneering motion-control work for *Star Wars*. He supervised visual effects for the *Batman* series before joining Sony Pictures Imageworks, where he just completed *Stuart Little*.

Thornton cut his teeth building miniatures for BBC sci-fi classics such as *Dr. Who* before moving to the United States and buying a Commodore Amiga. As cofounder of Foundation Imaging, he has contributed digital effects to a range of high-profile movie and television projects, including *Star Trek*, *Babylon 5*, and *Terminator 2*.

Tippett, founder of Tippett Studios, is the contrarian of the group. The experience of cooking up special effects for the *Star Wars* movies, supervising animation for *Jurassic Park*, and codirecting the battle sequences in *Starship Troopers* led him to the conclusion that computers are evil. He looks forward to a future of improved human/computer interaction.

Neil Trevett and Mark Sylvester represent the hardware and software industries respectively. An engineer who became seduced by marketing, Trevett is vice president of 3Dlabs. His ability to anticipate the twists and turns of the 3D chip market has made the difference between corporate survival and extinction.

On the software side, Wavefront cofounder Mark Sylvester has participated in the development of tools such as Composer and Universal Pictures' Advanced Visualizer. Working under the title of Ambassador for SGI's Alias|Wavefront division, his recent activities have included bringing computer graphics to Beijing University.

Some of these experts were hesitant to prognosticate. Others offered cautious predictions. The boldest of them untethered their imaginations and let them run wild. In all likelihood, of course, nothing will happen precisely as these pages describe—you might think of what appears here as an inner boundary of sorts. The future is sure to be wilder still.

by Ted Greenwald

Ed Catmull,

Executive VP and Chief Technology Officer, Pixar Animation Studios

If 3D graphics technology in the year 2000 were a cuisine, what cuisine would it be?

CATMULL Chinese food. Most of the elements are chopped up in little pieces, and using it is like having to eat with sticks.

What is the most important use of 3D technology that hasn't yet been fully realized?

CATMULL Virtual reality. The research has been very poor, and the underlying technology and promise haven't been achieved.

What must change to realize it?

CATMULL People need to stop trying to do their research by buying off-the-shelf technology. It's what I would call lazy research.

What will be the most important skills for professional artists and animators to possess in the coming decade?

CATMULL Fundamental art and science skills: drawing, color, composition, lighting, study of motion. Every studio encounters people who think they can become an artist without developing those skills. Wrong.

How will 3D graphics affect our everyday lives a decade from now?

CATMULL We are clearly moving towards more entertainment. I think everybody will find the economics to incorporate 3D into their work. It's already less expensive for us to produce, say, *Toy Story 2*, than it would be to produce a comparable 2D-animated film.

How would you describe your dream digital graphics system?

CATMULL A system that lets a small crew produce a good piece of art quickly and cheaply. Lighting would take place in real time. Animators would be able to concentrate on making characters come alive rather than worrying about logistics. Modeling and animation would take a short period of time, and the information flow around the studio would keep everyone continually apprised as to the status of the project.

What milestone will signal to you that 3D technology is mature?

CATMULL The industry will be mature when we stop have interesting technical problems to solve. And we're not there yet.

What is your wildest, pie-in-the-sky vision of 3D graphics at the approach of the year 3000?

CATMULL Actually feeling like you're in the 3D world. I'm separating out the technology from the content. The content is always going to be dependent upon artists and their particular visions. If I just look at the technology, the ideal point is that you feel like you're in the 3D world and you interact with it. We're a very long way away from that.

James Blinn,

Graphics Fellow, Computer Graphics Group, Microsoft Research

If 3D graphics technology in the year 2000 were a toy, what toy would it be?

BLINN It's sort of like an Erector Set. The pieces are basic shapes like polygons. You can construct more complicated things out of lots of polygons, like a monster or a building.

What is the most important use of 3D technology that hasn't yet been fully realized?

BLINN 3D user interfaces. Envision the configuration of your computer and the various system settings not as a bunch of menus and lists, but kind of like under the hood of a car. You can see different geometric shapes plugged into each other.

What must change in order to realize the 3D user interface that you have in mind?

BLINN Somebody has to design the metaphors and implement the software.

Do you have a sense of when that might occur?

BLINN It'll take awhile for it to percolate down into the user community. People are used to the handles they have now.

What will be the most important skills for professional artists and animators to possess in the coming decade?

BLINN Imagination.

How will 3D graphics affect our everyday lives a decade from now?

BLINN Most of the images on TV or in movies will be 3D graphics. Expectations will continue to rise, but the available tools will allow those expectations to be realized.

How would you describe your dream digital graphics system?

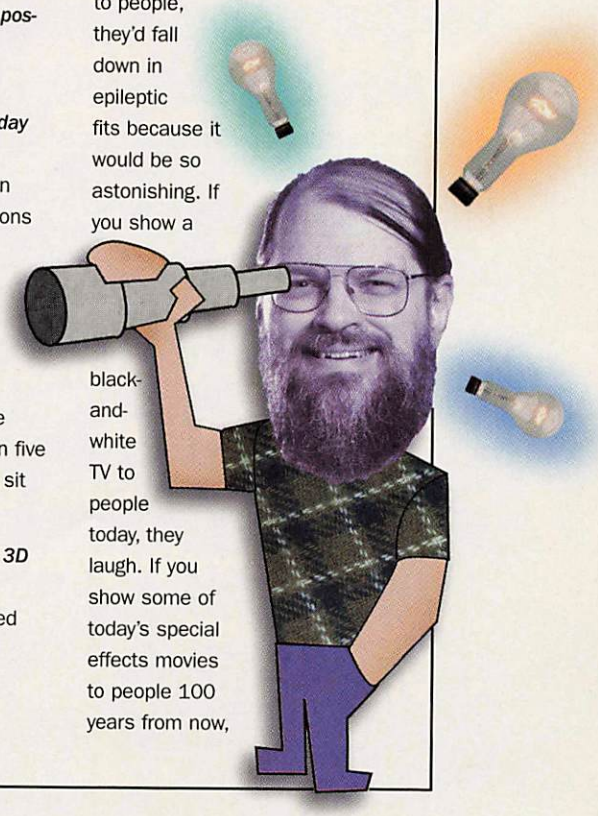
BLINN The systems available now are more than I would have expected even five years ago! What I need is the time to sit and learn to use them.

What milestone will signal to you that 3D technology is mature?

BLINN When people start getting bored with it. Which is starting to happen, I suppose.

Who's getting bored and why?

BLINN The technology is so common that people don't even notice it. If you took a black-and-white TV set back 100 years and showed it to people, they'd fall down in epileptic fits because it would be so astonishing. If you show a black-and-white TV to people today, they laugh. If you show some of today's special effects movies to people 100 years from now,



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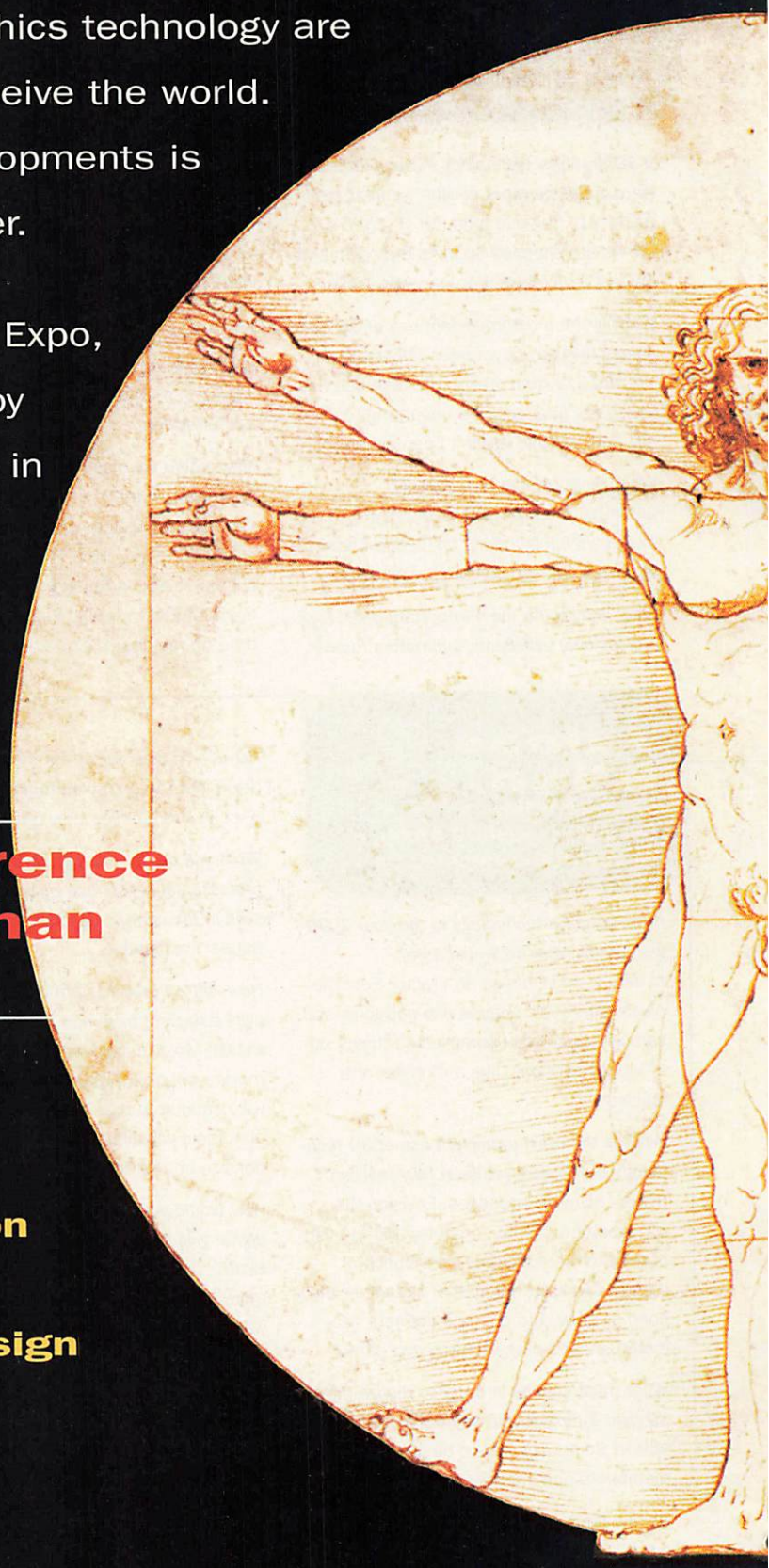

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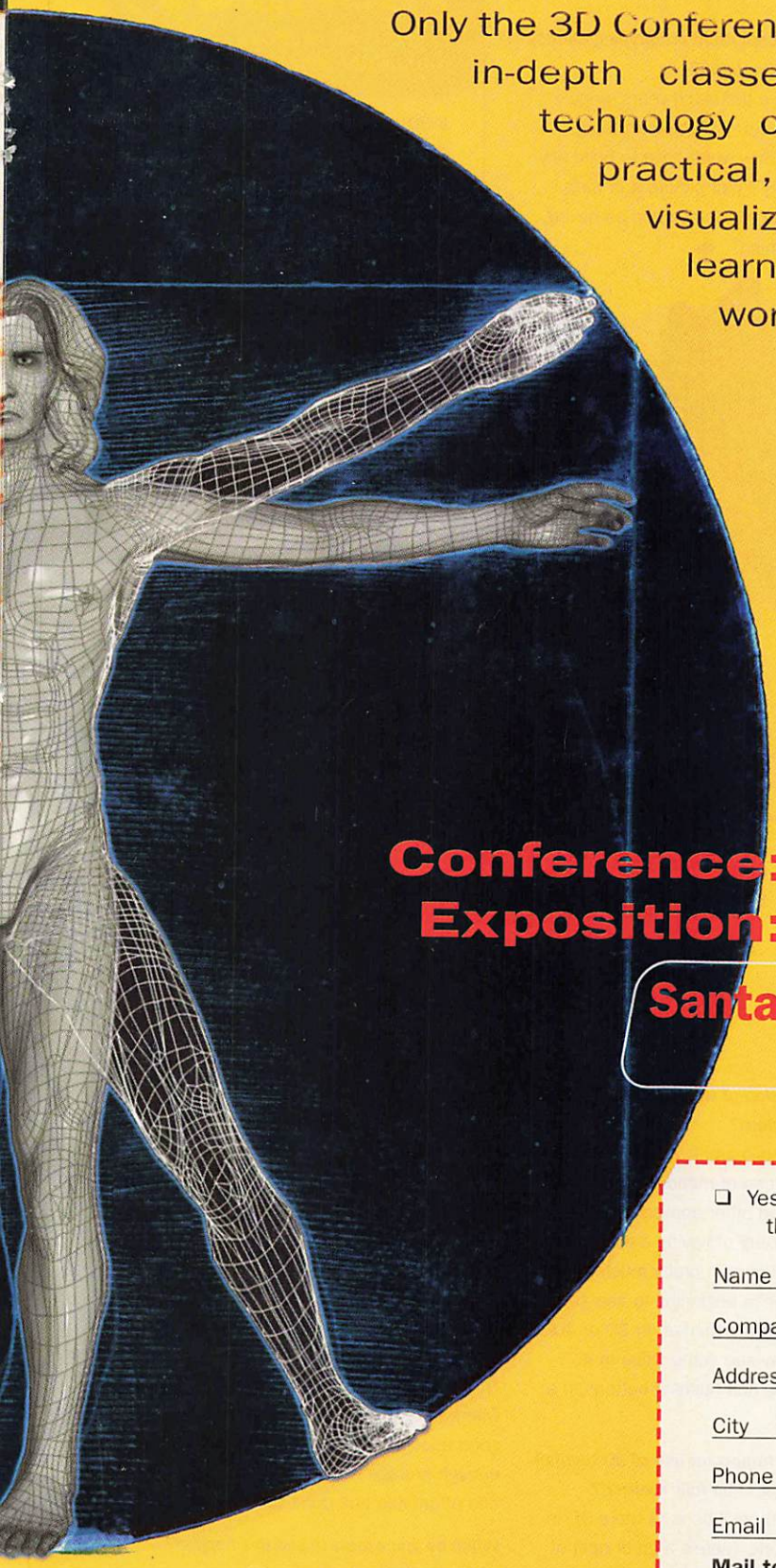

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they'll laugh too.

And what will their technology look like?

BLINN I don't know, but if we saw it, we'd fall down in epileptic fits.

What is your wildest, pie-in-the-sky vision of 3D graphics at the approach of the year 3000?

BLINN People will probably have some direct brain connection that allows them to manufacture things in their minds.

Like personal rapid prototyping directly linked to the brain?

BLINN In a thousand years, people won't need to prototype anything because they won't have to build anything. They'll just picture it in their minds and it'll be as good as having the real thing.

Ron Thornton,

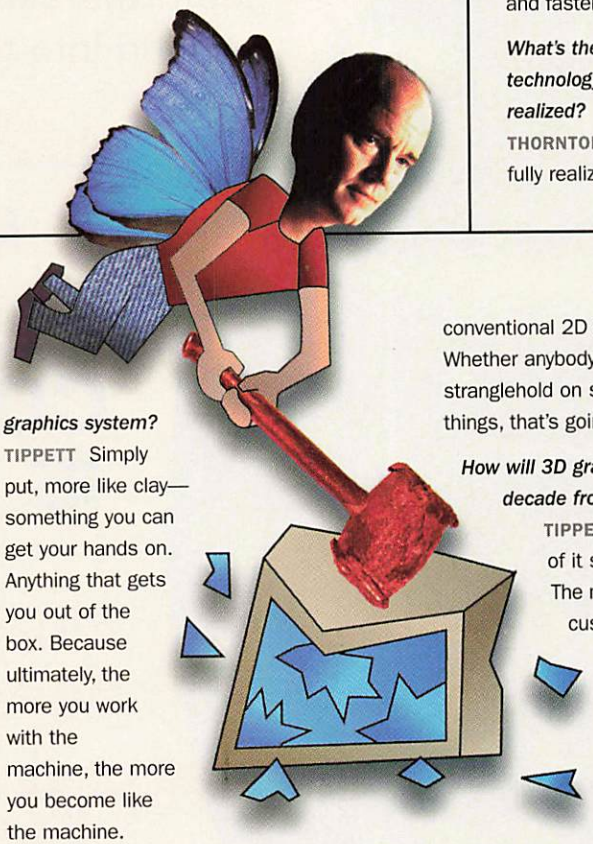
Executive Producer, Foundation Imaging

If 3D graphics technology in the year 2000 were a vehicle of transportation, what vehicle would it be?

THORNTON A Concorde. It was slow to start, and it just got faster and faster and faster.

What's the most important use of 3D technology that hasn't yet been fully realized?

THORNTON None of them have been fully realized. I don't think we'll ever get



TIPPET PHOTO BY FRANK MASI. ©1999 DREAMWORKS LLC

Phil Tippett,

Founder, Tippett Studios

If 3D graphics in the year 2000 were an animal, what animal would it be?

TIPPETT A skunk. They're pretty, and they're smart, and they stink.

What, in particular, stinks?

TIPPETT There are certain aspects of the working methodology that are very inhuman. As a result of being built by technically oriented people, computers are very counterintuitive. It makes the production process much more quantifiable, in an assembly-line modality, which makes it right for corporate thinking. But the corporate mindset and creativity don't necessarily evolve together. Also, sitting in front of a monitor all day long, playing with a keyboard or a mouse—that's not what people should be doing.

My background is sculpting and painting, stop-motion animation, photography—very much hands-on. What lured me into the circus was the big top, the trapeze, the clowns, the roar of the crowds, the smell of the greasepaint. It was the stage and lighting, working in a milieu where you used your body and sculpted the set over six weeks, lit it, animated it, and lived in it. Then you broke it down and swept everything clean, and you built a new one. It was a process I loved very much. It's difficult to see it reduced to a box.

How would you describe your dream digital graphics system?

TIPPETT Simply put, more like clay—something you can get your hands on. Anything that gets you out of the box. Because ultimately, the more you work with the machine, the more you become like the machine.

Do you have a vision of when you might actually have that system?

TIPPETT We've philosophically experimented with the possibilities of motion capture, interactive lighting, and other applications. But we don't have the luxury of having a billionaire behind us, so it'll remain pretty much in R&D mode for now. We're beginning to see some of these things hit the market. In 30 or 40 years, people may see some value in it, rather than sitting and pushing buttons in a chair all day long.

What's the most important use of 3D technology that hasn't yet been fully realized?

TIPPETT I think there'll be a lot more 3D in feature-length work. There's a great deal of interest in films that will take the place of conventional 2D animation and cartoons. Whether anybody can really break Disney's stranglehold on success and sell these things, that's going to be the trick.

How will 3D graphics affect our lives a decade from now?

TIPPETT We'll probably see more of it showing up in commercials. The more a part of the media circus you are, the more it will affect you.

What will be the most important skills for professional artists and animators to possess in the coming decade?

TIPPETT Observation of the world around them. How they move in space, how light bounces off surfaces, how things look and feel, and what the true relationships of things are. In a 2D medium like painting or drawing, a good artist will spend a lot of time out in the world observing and will bring that back to the studio.

What milestone will signal to you that 3D technology is mature?

TIPPETT When tools have reached the point where people can say, "These are actually good enough. This will do." When there's enough storage and things are interactive and affordable and don't break.

When do you expect to see this happen?

TIPPETT Not in my lifetime!

to that point. Filmmaking has been around since the early 1900s. It will continue to change. The same goes for 3D technology. Whether or not it goes in the right direction is up to whoever's running it at the time.

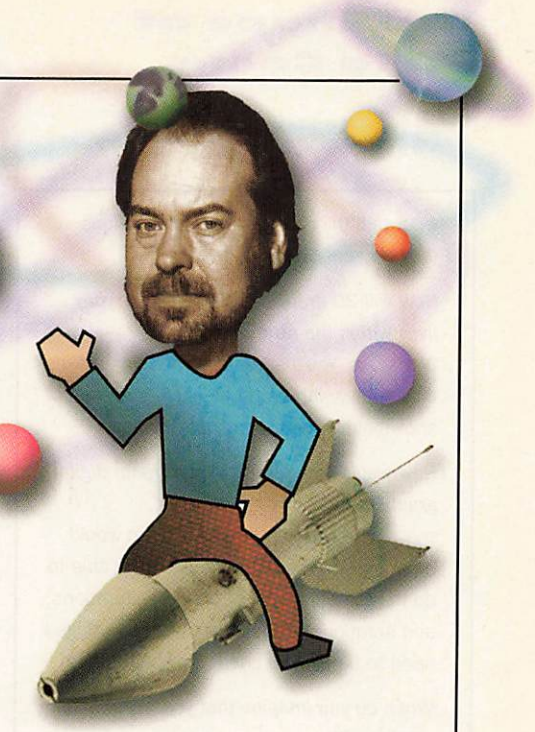
What do you think will be the most important skills for professional artists and animators to possess in the coming decade?
THORNTON Observation, self-honesty, and creativity.

So artistic skills are the predominant skills for the next decade?
THORNTON Always have been, always will be. There are still computer graphics facilities where movies are made predominantly by programmers and coders, which is stupid. The creation of the film should be left to the filmmakers.

How would you describe your dream digital graphics system?
THORNTON User interfaces need to become easier to use, with greater speed and quality of refresh. The setup would be along the lines of a network animating system, where a server is the core of whatever project you're working on. Each person has a workstation that handles their particular aspect of it, and that's all the workstation has to think about. Part of the server deals with backgrounds and what's going on in the background, part of it deals with atmospherics, and so on.

When do you imagine you might actually have it?
THORNTON According to the software companies, we've already got it. That's not to say that it actually delivers. But to give you an example, in the early 1990s, we were talking about doing digital dinosaurs. I said it was five years away at least. Then I got a call to help set up some stuff for *Jurassic Park*. Was I wrong!

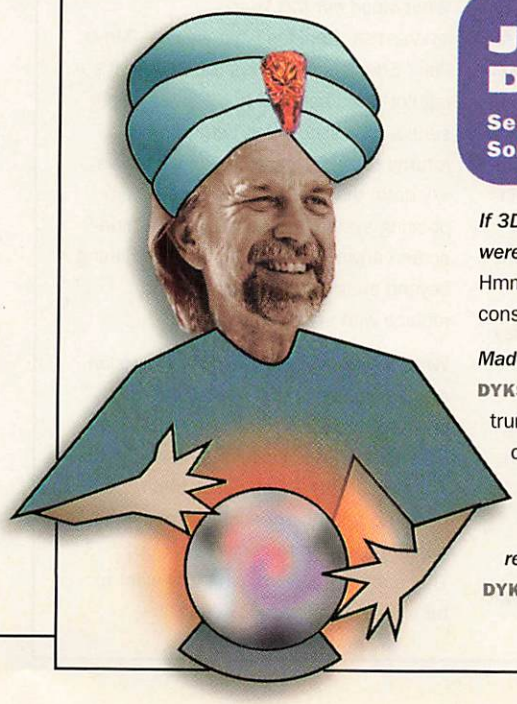
What milestone will signal to you that 3D technology is mature?
THORNTON Once it stops being a buzzword within the industry.



What is your wildest, pie-in-the-sky vision of 3D graphics at the approach of the year 3000?
THORNTON Direct neural connection. It'd be almost like *The Matrix*, where you could plug straight into it. It would be very dangerous.

Physically dangerous?
THORNTON Yeah, I think so. If you could just push a button and have sex with Cindy Crawford continuously, wouldn't you? You'd plug yourself in at about five years old, and then suffer a 75-year orgasm.

What's your wildest, pie-in-the-sky vision of 3D graphics at the approach of the year 3000?
TIPPETT Some kind of direct input system that eliminates the cumbersome aspects of motion capture. Being able to create an imaginary being in your mind where the acting itself is what you use to create your characters. What that thing is and how it manifests, I have no idea.



John Dykstra,

Senior Visual Effects Supervisor, Sony Pictures Imageworks

If 3D graphics technology in the year 2000 were a celebrity, what celebrity would it be?
Hmm. A celebrity who reinvents themselves constantly...

Madonna?
DYKSTRA I think there's a broader spectrum involved than Madonna! But, in an odd way, it's true.

What's the most important use of 3D technology that hasn't been fully realized yet?
DYKSTRA 3D design is going to become an integral part of production in film. For the *Batman* films, we did previsualization in 3D using simple forms with texture maps. We were able to do seven or eight iterations of a camera move in the time it would take to do one iteration with a real model and a real camera. Even though we ultimately shot real models with real cameras, we used the 3D surrogate to do iterations, and iteration is the thing that allows you to perfect a concept.

What will be the most important skills for professional artists and animators to possess in the coming decade?
DYKSTRA Artists and animators need to have a first-hand acquaintance with reality—a tactile, visual, auditory immersion in real things—in order to have a sense of

what real things are and what emotions they evoke in their raw form.

How will 3D graphics affect our everyday lives within the next decade?

DYKSTRA You'll see a guy changing brakes on a Chevy with a pair of glasses on that shows him what springs to remove.

How would you describe your dream digital graphics system?

DYKSTRA My ultimate 3D system would be oriented toward iterations. I'd be able to do things very quickly. Iterations, iterations, and iterations—those are the three things I need to be able to bring a concept to life.

When do you imagine that you might actually have it?

DYKSTRA It's probably three or four years away.

That's not a long time.

DYKSTRA It's just a matter of how fast you can do the calculations, and if you look at the curve of the increase in the speed of calculations year by year, it's pretty steep. That's why I think it can happen in that period of time. When it comes to artificial intelligence—when the computer starts to learn and have a sense of self—I think that's way down the line. But just the crowbar technology of finding points in space, connecting polygons, calculating trajectories and inertia and mass, and all that stuff, those are things we know how to do already. We've just got to get faster at it.

What milestone will signal to you that 3D technology is mature?

DYKSTRA When we go to 4D.

What is your wildest, pie-in-the-sky vision of 3D at the approach of the year 3000?

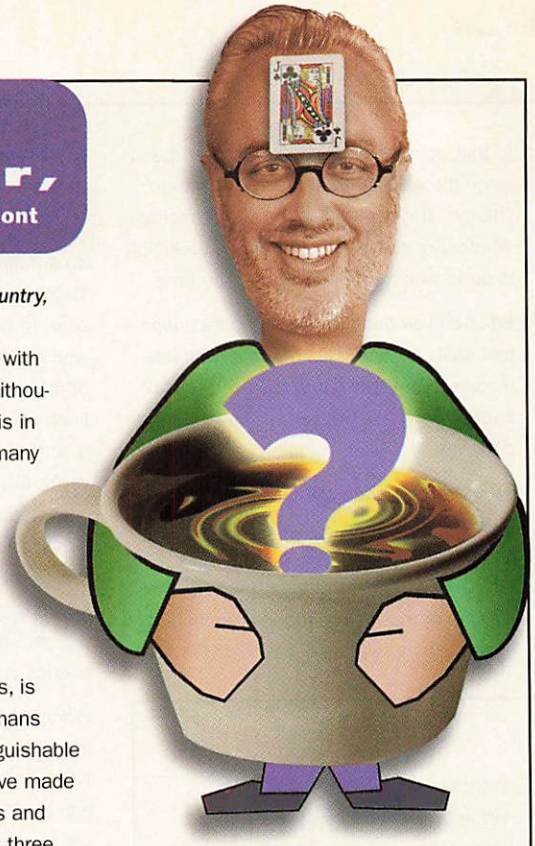
DYKSTRA At that point, it's going to be an issue of electromagnetic impulses from your brain. You'll be able to do performance-dimensional art, conceptualized and executed within nanoseconds.

Performance-dimensional art?

DYKSTRA Yeah. You'll be able to create an environment for people, complete with auditory, maybe even tactile, stimulation. Certainly, if we can get the information out of the brain, we can get it back in.

Mark Sylvester,

Ambassador, Alias|Wavefront



If 3D in the year 2000 were a country, what country would it be?

SYLVESTER China. It's a country with amazing potential. It's got a multithousand-year history, yet everything is in front of them. 3D is like that in many ways. It's big, it's established, it's deep, yet it's still new to so many people.

What is the most important use of 3D technology that hasn't yet been fully realized?

SYLVESTER The Holy Grail, for us, is digital actors. Synthespians, humans as well as animals, fully indistinguishable from their live counterparts. We've made great strides in the last 10 years and we've done really well in the last three years, but sometimes I think we have at least that much further to go. We've got them to where they look real and mostly act real, but only with a superhuman amount of work on the character animator's part. I want to be able to insert digital characters into episodic television, music videos, and the like, and that's probably still two to five years away. Clearly the building blocks are in place, but the whole marrying of natural languages, artificial intelligence, needs to happen.

What will be the most important skills for professional artists and animators to possess in the coming decade?

SYLVESTER The two most important skills are the ability to be an excellent communicator and the ability to build and maintain relationships. There are 50 things that you can become a specialist in, but all of them need these two abilities.

How will 3D graphics affect our everyday lives a decade from now?

SYLVESTER The computer's ability to visualize will probably have its most significant impact in the field of education, and that includes both educating our children and educating customers and employees.

How would you describe your dream digital graphics system?

SYLVESTER Voice-activated Seiko wrist renderer.

What milestone will signal to you that 3D technology is mature?

SYLVESTER I think it's mature now. How much groundbreaking invention is getting done? Only 30 papers were presented at SIGGRAPH this year. You go around the show floor and talk to people and say, "What shouldn't I miss?" and you get maybe one or two things. There's a lot of maturity there.

What stood out this year?

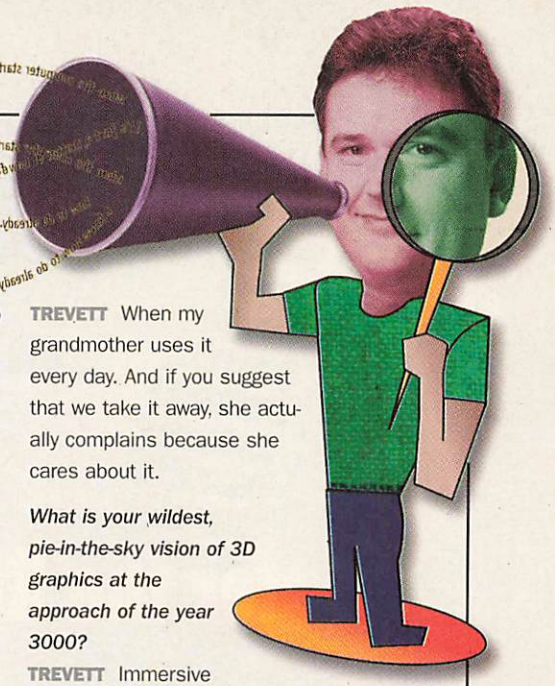
SYLVESTER Besides what we did—Maya Paint Effects—there was the Z-Cam. It's a regular video camera, but it has a depth sensor that shoots out infrared and returns real-time depth data, as well as x/y data, that you can feed into a compositing system. You don't need a blue-screen anymore. You can say, "Everything beyond six-and-a-half feet, clip and replace with some other image."

What is your wildest, pie-in-the-sky vision of 3D graphics at the approach of the year 3000?

SYLVESTER Well, I would think that we're well beyond the Holodeck by that time. If I want to tell a story about something, I ought to be able to conjure that up. That's really the word, isn't it? I want to be able to conjure it up.

Neil Trevett,

VP of Marketing, 3Dlabs Inc.



If 3D technology in the year 2000 were a fruit or vegetable, what fruit or vegetable would it be?

TREVETT A pineapple, because you have to figure out how to get through the tough, hard exterior to get to something wonderful inside.

What is the blade that cuts through that exterior?

TREVETT The most natural blade is going to be the OS itself. When that goes 3D, applications will quickly follow suit and a tremendous momentum will build up.

What's the most important use of 3D technology that hasn't yet been fully realized?

TREVETT E-commerce, 3D on the Web, stunningly realistic simulators and training.

What will be the most important skills for professional artists and animators to possess in the coming decade?

TREVETT The most important thing has nothing to do with technology. It's the artistic flame. On the technical side, we're still struggling to find an intuitive user interface. People will need to be able to visualize in 3D to effectively push the limits of the tools, rather than being limited by the tools.

How will 3D graphics affect our everyday lives a decade from now?

TREVETT We will be getting closer to immersive virtual reality environments. The entertainment possibilities are endless, although it's very easy to get addicted to that kind of immersive environment. It could end up like a bad sci-fi movie if we're not careful.

How would you describe your dream digital graphics system?

TREVETT I would love to have a truly immersive 3D user interface.

When do you imagine you might actually have it?

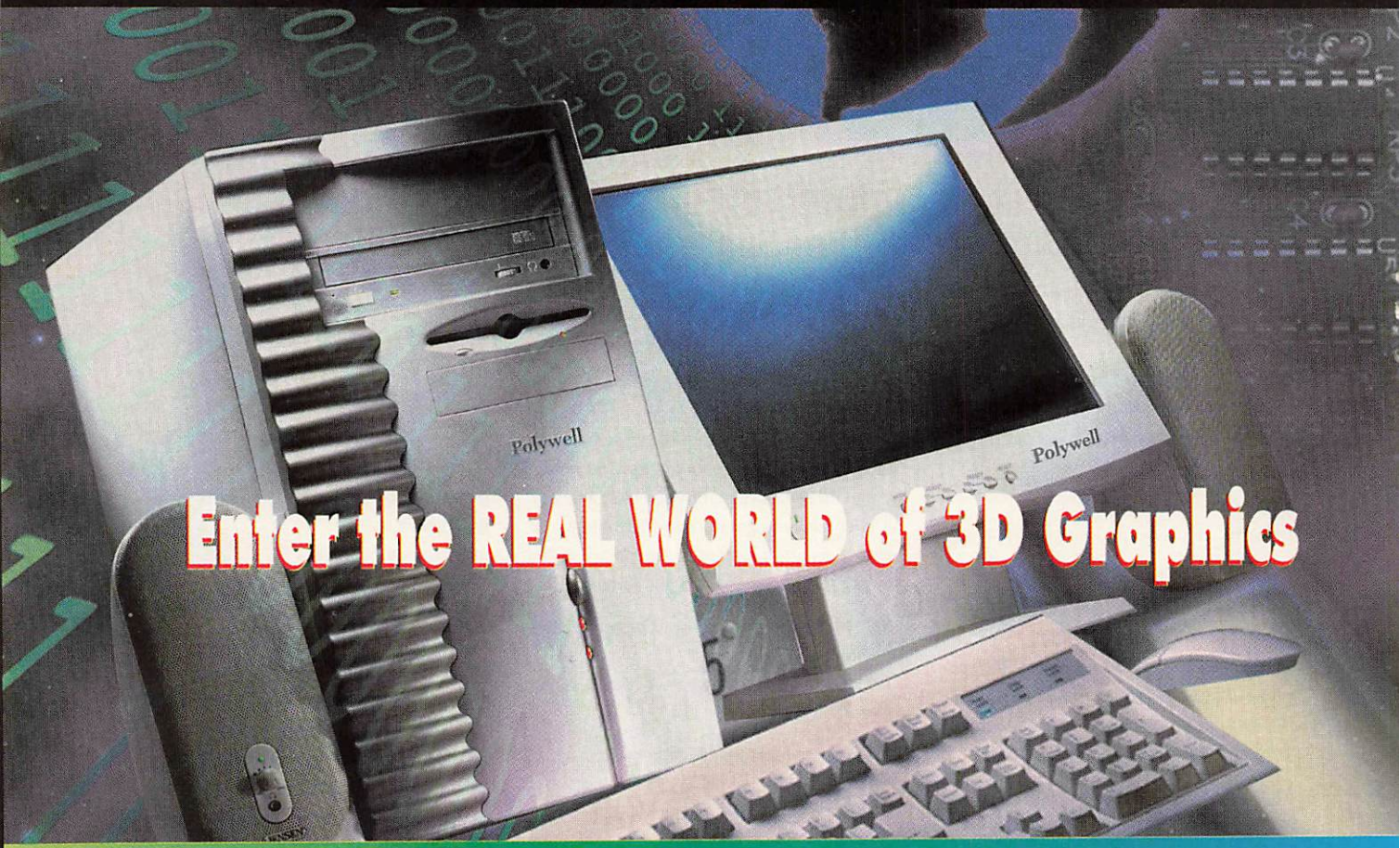
TREVETT Ten, fifteen, twenty years or more.

What milestone will signal to you that 3D technology is mature?

TREVETT When my grandmother uses it every day. And if you suggest that we take it away, she actually complains because she cares about it.

What is your wildest, pie-in-the-sky vision of 3D graphics at the approach of the year 3000?

TREVETT Immersive environments where it's impossible to differentiate the 3D environment from reality. In its best form, you can interact and create and do wonderful things that wouldn't be possible outside the environment. In its worst form, you can use it to disconnect from any kind of reality and never come back. Human nature being what it is, it'll be probably used for a bit of both.



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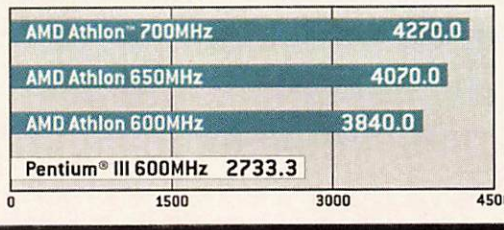

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BY MICHAEL REES

Monster Modeler

auto•des•sys form•Z 3.0

If you're upgrading to version 3.0 of auto•des•sys form•Z ($2,399), don't expect to go about your work as though nothing has changed. Although the latest version of this highly respected modeler retains the character of past revs, it's a different program. The primary differences are the addition of patch modeling and NURBS (called NurbZ in form•Z), as well as parametric modeling features. The cost is a challenging learning curve, even if you've had experience with earlier versions of the program. Moreover, the high degree of control form•Z gives you makes it necessary to prepare carefully.

An outgrowth of early research in computer-aided design, form•Z has an architectural flavor (as well as a strong architectural following) coupled with the ease of use associated with the Mac GUI, for which it was originally developed. Today, it's a mature, cross-platform application (Mac, Wintel, Alpha) with a robust feature set equally suited to character design, architecture, industrial and commercial products, sculpture, and so on.

form•Z provides a tremendous amount of flexibility. The upside is significant control over topological features. The downside is that there are several different types of objects that form•Z employs. The primary entity types are polygonal and NURBS objects, but it's necessary to attend to other object types, such as patch and derivative NURBS objects, as you work. Ignoring the type of object you're working on can result in losing control parameters, dysfunctional Boolean operations, and other downstream problems. (This is true in many other high-end modeling programs as well.) The solution is to prepare modeling sessions with clear parameters in mind, tweaking objects between entity types or rebuilding them while keeping their intended uses firmly in mind. (See "Managing Object Types," p. 47.)

The most immediately striking difference when you open up the program is the new palette arrangement, which further complicates an already cluttered GUI. Two interesting additions are Color Icons, which add a great look to the program (available via Palettes→Customize Tools), and the Tool Options palette (Figure 1).

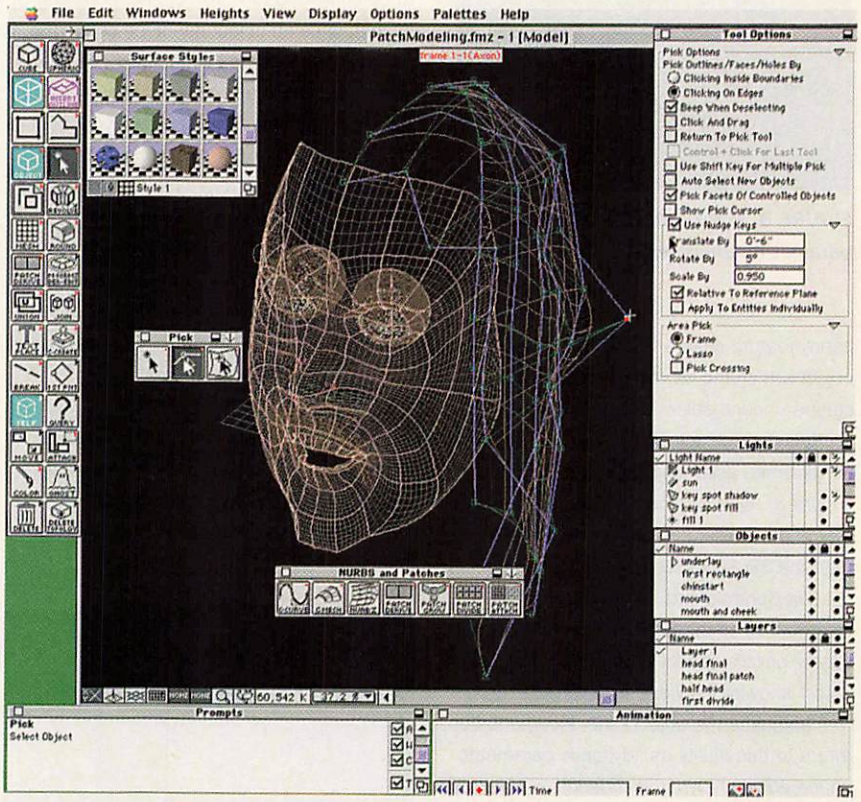

FIGURE 1. The new look of form•Z 3.0's palettes (plus a look at a new form•Z entity—the head and hair are patch modeled).

When you choose a tool, the Tool Options palette shows all the options for that tool. If you're accustomed to double-clicking or option-clicking to call dialog boxes, click no more. I found it a bit difficult to get used to—habit forced me to the dialog box every time. But once I became acclimated, remembering to look to the right rather than double click, it worked nicely. In a month-long modeling project, it might save a few hundred clicks. Veteran users may prefer to use the dialog boxes, if only to save screen space.

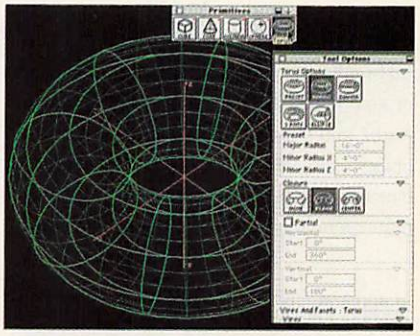

FIGURE 2. Parametric primitives are new to form•Z 3.0. After you create an object, you can edit it along its original parameters.

New Object Types Two new tools, Edit Controls and Edit Surface, take advantage of two new object types, called NurbZ and Patch. Both object types are parametric, and primitives are now fully parametric as well—a very

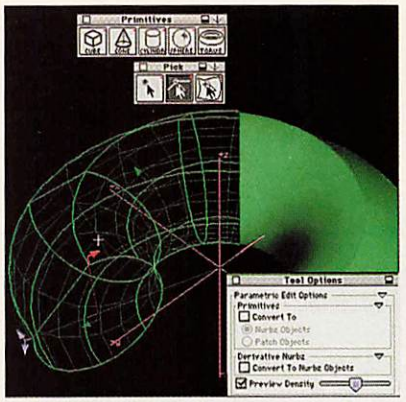

FIGURE 3. Edit Controls allows editing of parametric primitives.

handy feature (Figure 2). All edits to an object are stored as the object's history and can be undone selectively.

Edit Controls allows parametric objects to be reformed according to their parameters (Figure 3). Edit Surface lets you rescale parametric primitives and requires fewer clicks than the 3D Scale tool.

Edit Controls and Edit Surface are located next to the Selection tool. In both cases, arrows appear around the selected object showing how and in which directions to manipulate the object. The documentation refers to this ability as "dynamic parametric shape editing." Dynamic indeed!

In addition to being a lot of fun, these tools extend form·Z's modeling capabilities in a big way. While setting up the figures for this article, I found it difficult to keep on task as I moved through various permutations of the tools. For example, not only can you use Edit Controls to alter the parametric aspects of a primitive, you can also click Convert To NurbZ and the object will become a NURBS object with controls that can be pulled in any direction, and handles, points, and segments that can be manipulated (Figure 4). Edit Surface allows you to grab and pull the mesh. Using a new feature in the Query tool, you can access these tools by clicking the Edit button.

It's possible to switch back and forth between object types using Drop Control. This allows plain objects and parametric primitives to be converted to NurbZ or Patch objects. Of course, once an object has been converted, you lose some control over parametric features. (You'll recognize this experience when the program asks, "This will clear your control parameters, do you wish to continue?") Consequently, it's best to reserve these types of operations for the end of a modeling session. The temptation to turn the control parameters of an object off can create trouble down the road, so exercise caution. You can also change object types using various features in Edit Controls and Edit Surface.

NURBS & Polygons The ability to handle both NURBS and polygonal information with ease sets form·Z apart among mid-range CAD-capable modeling apps. It would be hard to find a program, even at a much higher price, that offers this much control. For animators, it allows fine-tuning of shapes and seamless texture mapping. For industrial designers, architects, and sculptors, the ability to control the look of each and every facet on an object's surface adds amazing textural potential.

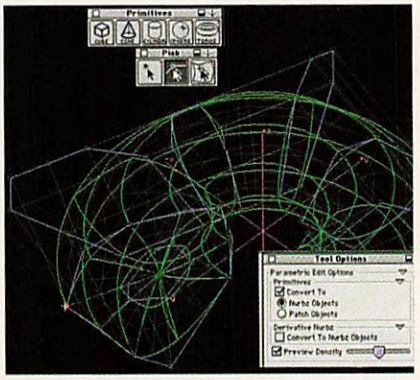

FIGURE 4. The same object after selecting Convert To NurbZ in Edit Controls.

NURBS and polygonal objects can be output in file formats suitable for rapid prototyping (RP), where they are tessellated by default. This is a big help for designs destined for toy manufacture and the like, which can be prototyped inexpensively for proof of concept and market research. (RP is a computer-controlled manufacturing process in which CAD data is used to shape physical objects directly. You might think of it as WYSIWYG 3D printing.) Moreover, form·Z IGES files can now go out to CAM (computer-aided manufacture), where NURBS entities can control tool paths and cutters to produce physical objects with exquisitely finished surfaces. (CAM is not a push-button technology like RP, but it can achieve greater precision and is capable of generating high-strength steel molds for heavy manufacturing.)

form·Z's RP- and CAM-ready output is outstanding. Because it started as a polygonal solids modeler, form·Z handles normals correctly, which is essential for RP and CAM. In contrast, NewTek LightWave creates major problems when exporting to manufacture.

Navigation & Documentation Navigation is a critical aspect of any program. Unfortunately, form·Z 3.0's new navigation tools—Set View, Navigate View, and Walk View—are not up to par. Set View (Figure 5) now has a dialog box so you can choose the point around which the current scene will be rotated. This seems to work differently on Mac and Windows—a drag for dual-platform users. Navigate View (Figure 6) pops up a strange target icon with different select and drag options. I spent a lot of time figuring out which one did which thing. Walk View (Figure 7) works well; it spins an object about its axis with a single click. Match View is form·Z's perspective-matching tool, retained from an earlier version.

My major complaint about navigation is that to activate these tools, it's necessary to step out of the active modeling space. You can't model and navigate simultaneously without stepping back via multiple mouse

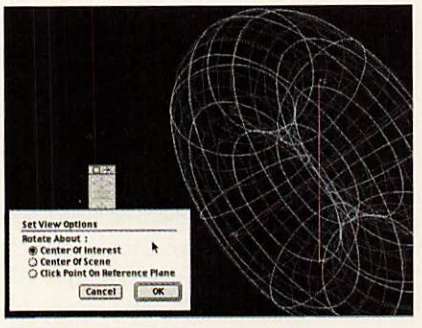

FIGURE 5. Set View, probably the most useful navigation tool.

sources

form·Z 3.0 · list price $2,399
auto·des·sys
(614) 488.8838 · www.autodessys.com

SYSTEM REQUIREMENTS:
·Macintosh: PowerMac, OS 7.1.2 or later; 8MB RAM (16MB recommended); 10MB hard drive space.
·Windows 95/NT: Pentium (Intel, Alpha); 16MB RAM (24+ recommended); CD-ROM, 10MB hard drive space.

clicks. It's awkward at best, a drag on productivity at worst. Unfortunately, no key commands activate the navigation tools. Key commands invoke the dialog boxes associated with the tools, but they don't activate navigation. Moreover, the Navigate View's screen graphics are clumsy and fall short of the general aesthetic of the program. form·Z's navigation tools have fallen behind those of some other 3D modeling apps.

The documentation is complemented by several books written by independent authors, including *Into 3D with form·Z* by Lachmi Khemlani (McGraw-Hill) and *form·Z: Modeling for Digital Visual Effects and Animation* by David Rindner (Charles River Media). These books are available separately from the publishers and complement form·Z's excellent manuals, which are comprehensive and clearly written.

A Master Modeler The array of features discussed in this review only hints at the power of form·Z 3.0. Many subtle additions and improvements make this a powerful upgrade. For example, the Line tools now include excellent spline drawing procedures. Derivative objects (such as sweeps, revolutions, and helixes) are now parametric. Objects can be displayed at simpler resolutions via the Cage tool, or facets can be added or subtracted from a mesh using Smooth Mesh or Reduce Mesh. A small but welcome addition to the Parallel Shape tool is the ability to work on the same plane as the original shape. Symbols can be edited directly and layers can now be grouped.

form·Z has always been characterized by special twists that allow for greater control over object design. The Metaformz object type, introduced with version 2.9, is a comprehensive implementation of metaballs. Skinning, which is more permissive in version 3.0, allows for several types of implementation, from simple cross-skinning to multiple-path, multiple-source generations. This is valuable both for product design and character animation. Patch modeling, which has been implemented in the deep, fluid fashion form·Z users have come to expect, allows for careful construction of heads, bodies, and the like by extending edges of planes or shapes toward other edges or shapes (Figure 8). And the new NURBS capabilities are very powerful and exciting. Version 3.0 also adds basic animation, mainly geared toward architectural walk-throughs.

In many ways, all modelers are the same underneath the hood. The differences generally boil down to user interface and workflow. form·Z 3.0 maintains a competitive edge against higher priced programs such as Alias Studio. At the lower end, a host of new competitors threatens its position. Although Robert McNeel & Associates Rhino, Nichimen Nendo, TGS Amapi, and others are less costly and easier to learn and use, they can't touch form·Z 3.0's well-rounded toolset.

If you work for a big studio and you've invested megabucks and megatime with Alias|Wavefront Maya or Softimage, this program isn't for you. But if you're out there on the edge making art, animation, or designs using lean machinery and low-cost solutions, form·Z 3.0 won't let you down.

Michael Rees uses CAD modeling and rapid prototyping to create fine-art sculptures. His work has been exhibited in the United States and Europe, including the 1995 Whitney Biennial in New York. He can be reached at www.michaelrees.com.

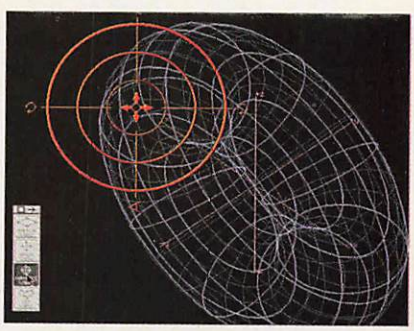

FIGURE 6. The awkward Navigate Tool, ripe for improvement.

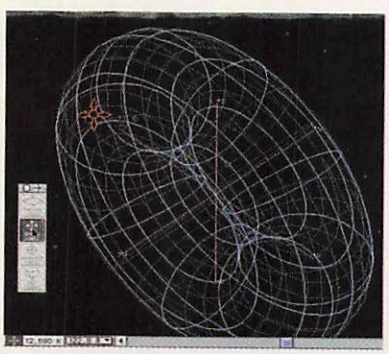

FIGURE 7. Walk View can be handy but is strange to get used to.

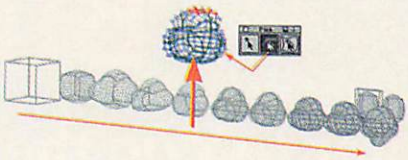

FIGURE 8. From a form·Z tutorial, a cube develops into a mouse head. This patch object is manipulated primarily through the Edit Controls tool.

managing object types

You can't judge a book by its cover, nor can you judge an object by the way it looks. With the addition of NURBS, patch object types, and more complex parametric features, form·Z lets you convert objects between types easily. Unfortunately, they can lose their control functions after undergoing Boolean and other operations.

Managing object types in form·Z is an important part of working with the program. For example, if you're preparing a model for animation that's also destined to become a prototype for a toy, you must maintain the object as solid throughout your modeling process.

Two ways are available to find out the nature of an object at any given point in the modeling process. One is the Query tool, which now includes an Edit button. The resulting dialog provides the most important information: whether the object is surface, solid, meshed, closed or open surface, parametric, Metaformz, and so on. All of the information about the object is available here. The Edit feature works the same way as the original Derivative Object's dialog window.

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BY BRENDON PERKINS

Harmonic Conversions

Okino PolyTrans 2.2

Viewpoint Interchange 5.5

If you work in 3D, chances are you rely on multiple software applications to complete your work—modeling, animation, rendering, image processing, and video editing apps; perhaps more than one of each. So it's interesting to note that no file format standard is accepted throughout the industry for exchanging 3D data among applications. On the other hand, it's not likely that one will emerge. Tool developers strive to create marketable advantages for their tools, and these advantages are reflected in, or implemented as, mutually incompatible file formats.

In lieu of a standard exchange format, most applications provide a limited set of import and export routines. But these routines usually don't provide a complete solution. In many cases, they don't account for intricate differences between formats that might help optimize models for the target application. Furthermore, they rarely deal with anything other than geometry. If you need a complete conversion that includes texture maps, animation paths, and the like, the usual import/export routines fall short.

The simple fact is that converting between 3D formats isn't a straightforward task, and vendors have little incentive to develop top-notch conversion utilities. Consequently, there's room in the market for specialized file format conversion applications.

Okino PolyTrans 2.2, a reduced version of the company's NuGraf rendering system, converts between more than 50 3D file formats and approximately 10 2D formats. It's available for Windows ($395) and IRIX ($495), and free demos can be found at the vendor's web site. A few of the conversion routines are sold separately by PolyTrans. For Windows, they include the IGES (Initial Graphics Exchange Specification) import converter ($195), the Softimage and OpenFlight (made by MultiGen) import/export converters ($245), and the ACIS SAT import converter ($195) to support the 3D toolkit from Spatial Technology. For SGI, they include the IGES import converter ($245) as well as the Softimage and OpenFlight import/export converters ($300). I evaluated PolyTrans using Windows NT.

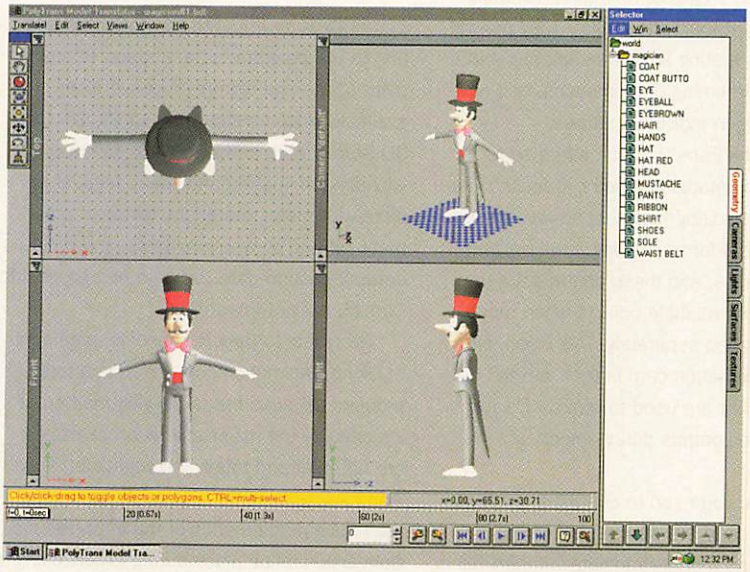

FIGURE 1. The user interface of Okino PolyTrans 2.2 is similar to that of many popular 3D applications.

PolyTrans' closest competitor is Viewpoint Interchange 5.5. Since acquiring Interchange from Syndesis in 1997, Viewpoint has improved it to the degree that it now supports more than 40 3D formats and eight 2D formats. Interchange is available for Windows ($495) and IRIX ($1,495), and demo versions can be obtained from the company's web site. Multiple user discounts and site licenses are available. Both PolyTrans 2.2 and Interchange 5.5 will run on any Windows or IRIX machine that can handle any of the major 3D apps.

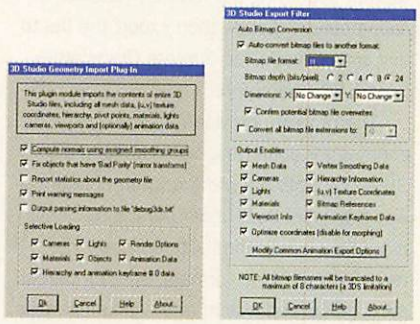

FIGURE 2. These dialog boxes are typical of PolyTrans 2.2's import/export controls.

Okino PolyTrans 2.2 PolyTrans 2.2 is targeted at users who need quick and accurate file format translation, and there is no question that it offers the best import/export converters currently in existence (Figure 1). Developed over a decade, the latest version covers CAD, IGES, .slp, .stl, .dxf, ACIS SAT, content creation (Discreet 3D Studio MAX, NewTek LightWave, and Avid Softimage), visualization and simulation (OpenFlight), and game development (OpenGL, DirectX, Renderware). It supports meshed polygons with recursive holes; NURBS, bicubic patches, and quadrics; smoothing data with vertex normals; UV texture-mapping coordinates, bump-mapping data with tangent vectors; lights; cameras; and even animation in a few cases.

The user interface is easy to use and uncluttered, presenting the familiar four views (top, right, front, and camera). For each view, a toolbar pops up when you left-mouse-click over the title bar. These menus provide controls for such operations as zooming,

panning, camera placement, and so on.

The Selector window is available for selecting objects, instances, cameras, lights, and other items. All items are listed using an indented outline format that indicates the hierarchical relationships, and these relationships can be changed. Animation controls are located at the bottom right. They provide features for editing keyframes, playing and adjusting the timing of animations, and navigating between individual frames.

Since PolyTrans 2.2 isn't intended for manipulating model geometry, it doesn't provide a lot of editing features; however, it provides controls for translating, rotating, and scaling objects, and these controls are useful for placing multiple objects when they must be loaded separately. This clean, simple implementation carries over into the dialog boxes that are used to provide file format-specific controls during import and export.

Whether you need to convert a model or an entire scene, it's often as simple as importing the model (Translate→Import 3D Geometry) and exporting to the desired file format (Figure 2). You may also load files without specifying the format (Translate→ Auto Detect & Load), then export the file to any of the supported formats (Translate→ Export 3D Geometry).

The program provides a broad range of controls for optimizing conversions (Figure 3). All controls are provided with default values that work best under most situations. I tested the application with several large models in different formats, and the default settings worked well in most circumstances. In some cases, you may have to edit exported files by hand, but this is to be expected. It wouldn't be reasonable to expect perfect translations in all situations.

Batch conversions are a very useful capability. This utility is versatile in the sense that it allows you to perform conversions on multiple files with different input/output formats in the same batch. The user interface makes it easy to specify the export format and control settings for several input files so that batch conversions can be defined quickly.

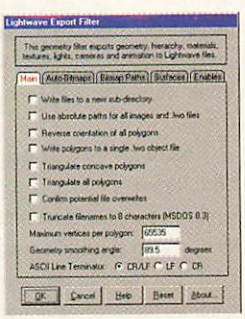

FIGURE 3. PolyTrans 2.2's features for optimizing conversions are more extensive and better organized than equivalents in Viewpoint Interchange 5.5.

Scene Conversion The most notable addition to the program is the support for complete scene and animation conversions, available since version 2.1. 3D Studio 4.0, 3D Studio MAX, and LightWave can now exchange animation and scene files, complete with mesh, materials, textures, automatic bitmap conversion, lights, and cameras. Animation data can also be exported to DirectX, but not imported.

According to Robert Lansdale, president of Okino, "Animation conversion is a tough problem because the underlying mathematics used by the major animation packages are different and totally incompatible." PolyTrans 2.2 represents animation data using the native mathematics of the imported file. Conversion takes place during export using a keyframe resampling algorithm.

PolyTrans 2.2 removes redundant keyframes, including those introduced by oversampling in motion capture files. Redundant keyframes are removed by specifying distance and angular difference thresholds. In some cases, removing keyframes may lead to jitter in motion paths, but I didn't encounter this problem during several conversions using the sample scenes provided with MAX 2.5 and LightWave 5.5.

NURBS Conversion NURBS files can be imported, cleansed, and even triangulated into polygonal meshes before you export to other formats. As part of cleansing, the program checks consistency of trimmed NURBS during import and makes corrections when mathematically possible. In rare cases, trimmed NURBS surfaces exhibit illegal definitions, such as when a trimming curve loops back upon itself or crosses over the boundary of the NURBS surface. PolyTrans 2.2 can occasionally correct these problems. Even so, there's no guarantee you'll be able to translate all data sets accurately between the supported rendering formats.

This unfortunate fact can be attributed, in part, to applications that have less-than-desirable NURBS implementations. For instance, MAX doesn't recognize NURBS surfaces with tangent discontinuities. These occur in surfaces that have creases where the surface tangent is undefined. Moreover, MAX doesn't properly support the import of trimmed NURBS from other applications. I created a trimmed NURBS surface in Rhino (from Robert McNeel & Associates) that I exported to .obj format. When I tried to import the .obj file into MAX using the PolyTrans 2.2 import routine, I was prevented from importing the object as a NURBS surface. The PolyTrans 2.2 import routine disabled all NURBS-related controls, so the object could only be imported as a triangulated polygon mesh. I had the same problem when I tried to export the surface to MAX directly from Rhino. The point is that PolyTrans 2.2 does convert NURBS to MAX format, but MAX's implementation prevents NURBS from being imported from other applications.

Nevertheless, PolyTrans 2.2 provides controls in its import/export dialog boxes that allow you to specify parameters for triangulating the NURBS surface into a polygonal mesh that can be imported instead. For trimmed NURBS, the application offers an

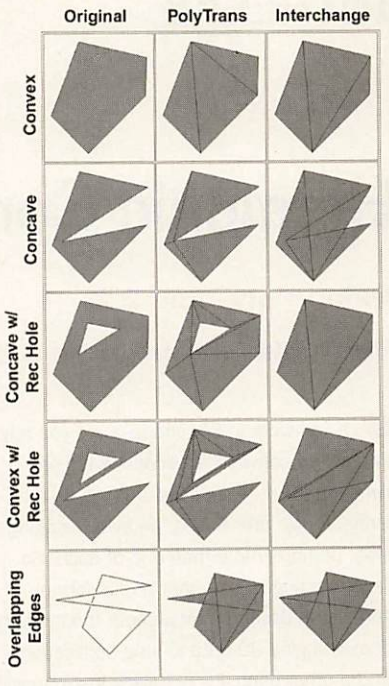

FIGURE 4. When implementing conversions, it's sometimes necessary to triangulate convex and concave polygons with recursive holes into multiple polygons with only three sides each. For the sample polygons shown, PolyTrans 2.2 performed the task properly. Interchange often didn't.

sources

PolyTrans 2.2 · list price $395 (Windows), $495 (IRIX)
Okino Computer Graphics Inc.
(905) 672-9328 · www.okino.com

Interchange 5.5 · list price $495 (Windows), $1,495 (IRIX)
Viewpoint Digital
(801) 229-3000 · www.viewpoint.com

adaptive subdivision method for triangulation, with slider controls that allow you to adjust the smoothness of the resulting surface. At the same time, you can also specify parameters for creating smoothing groups (with vertex normals).

Additional Capabilities Some formats, such as Wavefront (.obj) and Softimage (.hrc), allow for n-gons (polygons with more than three sides) and recursive holes. Other applications, such as 3D Studio DOS, MAX, and DirectX, allow for three-sided polygons only. To resolve this conflict, a conversion utility must rely on triangulation routines that break n-gons into multiple polygons with only three sides each. But beware! There are many algorithms for implementing triangulation, and some are better than others.

PolyTrans 2.2 uses a triangulation method called trapezoidal decomposition that's very good at reducing these types of polygons even when the polygons are improperly defined. Take, for example, a concave or convex polygon that's defined with a recursive hole and edges that overlap (not good). PolyTrans 2.2 will triangulate the polygon to produce a well-optimized and valid specification for the target format.

To test the PolyTrans 2.2 triangulation routine, I converted several complex polygons from Softimage (.hrc) to 3D Studio (.3ds) format (Figure 4). PolyTrans 2.2 produced the correct result in all cases. Since the last case represents an ambiguous definition, there's no correct result that should be expected. However, it's interesting to note that PolyTrans 2.2 produces a result that better matches the footprint of the original polygon as compared to the result obtained with Interchange.

There are things PolyTrans 2.2 doesn't do, and Okino makes no apologies. For example, it doesn't convert from UV texture mapping to the projection methods used by LightWave and Play Electric Image. From Okino's point of view, projection mapping is antiquated and if you're using a rendering engine that doesn't provide UV capabilities, you should consider a switch. Lack of UV texture mapping has been a disappointment to LightWave users, but the soon-to-be-released version 6.0 includes UV. Meanwhile, Okino recommends the UView texture-mapping utility and shader plug-in from CineGraphics (www.cinegraphics.net) for getting UV coordinates into LightWave.

Viewpoint Interchange 5.5 If you don't need full scene and NURBS conversion, consider Interchange 5.5 (Figure 5). This application translates polygonal meshes among more than 40 formats including 3D Studio (.3ds and .max), LightWave (.lwo, .lws), Softimage (.hrc), AutoCAD (.dxf), Nichimen (.geo), QuickDraw 3D (.3dmf), and Wavefront (.obj). Interchange also converts textures for a limited number of formats such as Softimage (.hrc), 3D Studio 4.0 (.3ds), Wavefront (.obj), LightWave (.lwo, .lws), MultiGen (.flt), and

Coryphaeus (.dwb). Supported bitmap formats include .jpg, .tif, .gif, .png, .tga, and .rbg.

Operating Interchange 5.5 is very similar to operating PolyTrans 2.2. You import a model into the application (File→Import), where you can view it and perform limited editing operations before exporting to the target format (File→Export). When importing, you don't need to specify the file format, thanks to program's ability to detect file formats automatically. In general, the application provides extensive controls for optimizing conversions (Figure 6), and the default setting will work well in the vast majority of circumstances. As with PolyTrans 2.2, a batch-conversion function makes it easy to convert multiple files among multiple formats in a single operation.

Prior to version 5.5, Interchange offered no capability for viewing models before exporting them, but the newly updated user interface provides four viewports and a Selector window. In fact, the interface looks very similar to that of PolyTrans 2.2, and it provides comparable functionality. Right-clicking the mouse over any of the viewports yields a toolbar pop-up that provides controls for configuring the viewports. Additional controls are accessible from the main menu system.

Editing controls are provided for translating, rotating, and scaling objects prior to export. The application also provides controls for editing pivot points, which can be moved to new locations by graphically placing them within the viewports. The Selector window provides a convenient way to select specific objects and materials and to edit object hierarchies and object names. Double-clicking on a material opens the Materials Editor, which allows you to adjust values for the ambient, diffuse, specular, filter, and emissive properties, displaying the result on a smooth-shaded sphere (Figure 7).

Additional Capabilities As a top vendor of 3D models, Viewpoint has a lot of experience with file formats and the differences among them. For instance, 3D Studio and LightWave formats both impose limits on the number of points and polygons per object. When converting large models from other formats that don't impose these limitations, Interchange automatically divides large objects into smaller parts. Similarly, DirectX allows texture maps only if their dimensions are powers of 2. Interchange takes this into account and scales textures as required.

Another nice touch: If textures aren't located in the same directory as the parent model, Interchange searches multiple directory paths to locate them. Interchange 5.5 supports UV texture mapping.

Like PolyTrans 2.2, Interchange uses a triangulation routine to convert n-gons to triangles. I performed the same tests, and found that Interchange produced incorrect results for all but the first case (Figure 4). The triangulation routine didn't recognize the concave polygons and recursive holes. Since the overlapping edges of the last case represent an ambiguous polygon definition, no particular output is expected. I've included it simply for additional perspective.

Notwithstanding these limitations, Interchange 5.5 performs high-quality conversions in most circumstances. I tested it using several large files and didn't detect problems in any of the models I converted.

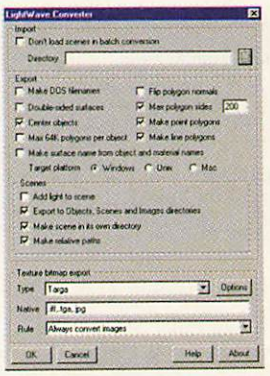

FIGURE 6. Interchange 5.5's controls for optimizing file format conversions.

FIGURE 7. Access Interchange 5.5's materials editor by double-clicking any material in the selector window of the main interface.

Preaching to the Converted PolyTrans 2.2 is one of the most useful applications currently available to 3D artists. The manuals are complete and technical support is top-notch. Okino's web site provides extensive information for each of the import/export routines.

As for Interchange 5.5, Viewpoint has made significant improvements in the latest version, and the company also provides excellent documentation and technical support (with unlimited access for registered owners). It's a formidable, if less feature-laden, tool. Its main shortcoming is the lack of support for NURBS, and its less effective handling of n-gons is significant.

In many other respects, these two programs are equivalent, leaving PolyTrans 2.2 with the edge in price (unless you need support for a file format that requires an additional module, in which case it's considerably more costly). Fortunately, free demos are available online, so you can try them both out and decide which best suits your needs.

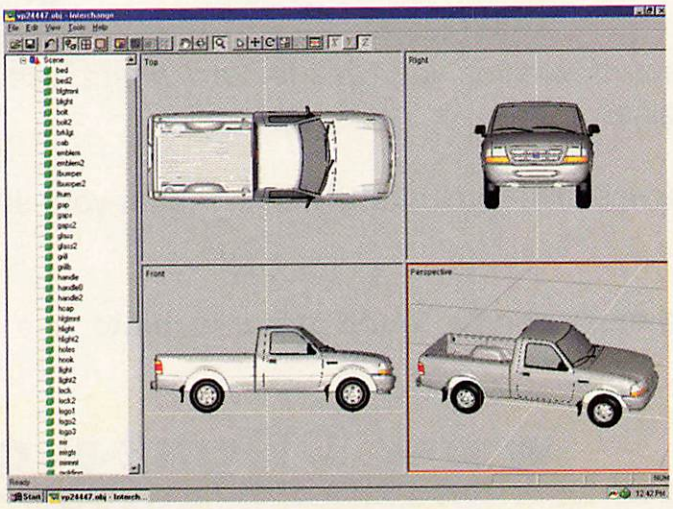

FIGURE 5. The main user interface of Viewpoint Interchange 5.5 is almost identical to that of PolyTrans 2.2.

Brendon Perkins is author of *Photoshop Magic: Expert Edition* (Hayden Books, 1997). He can be reached via email at user1851@erols.com.

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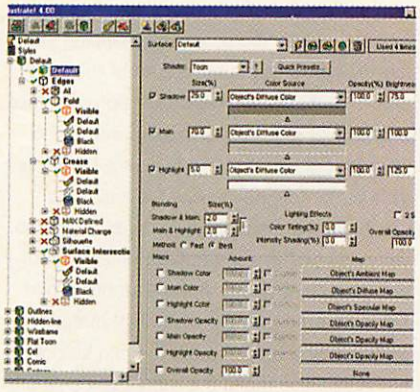

FIGURE 1. The Illustrate! 4.0 interface.

Vectors, Lines, & Toons

Digimation Illustrate! 4.0

for 3D Studio MAX

BY DAVID DUBERMAN

Digimation Illustrate! 4.0 (developed by David Gould) for Discreet 3D Studio MAX lets you render line drawings and toon-style images and animations. Its most outstanding feature is the ability to output vector-graphics images in Adobe Illustrator and Autodesk DXF formats. Even cooler than that—new in version 4.0—is optional Flash SWF output, thanks to Macromedia having published the Flash internal specs. Using Illustrate!, you can create vector animations for your web site without using Flash or being able to draw.

Because it can do comic-style rendering, you might think Illustrate! is similar to Meme-X The Incredible Comicshop, but it isn't really. It doesn't use special materials, nor does it support variable line weights. Like Comicshop, it's not multithreaded, but it's a lot faster.

Illustrate! works on many levels. If you want fast results and are willing to accept presets, you can use a rendering wizard to define the output format and assign Illustrate! to MAX's draft and/or production renderer, then set the background color (or map, with some formats), drawing style, and output options: number of frames, resolution, and filename. The available drawing styles include hidden-line, outline, wireframe, flat, cartoon, cel, and comic. You can transfer styles among objects using a Material Editor-style interface. You can also enable and disable edge and surface rendering.

At the next level, you can determine which of the six edge types are drawn. These include two different types of outline; edges defined by MAX; object intersections; and Crease, where different smoothing groups or materials meet. But it's at the deepest level that you get the most control. Using an Explorer-style tree view (Figure 1), you can customize any of the stock styles or create new ones by defining edge and surface characteristics. You can specify different characteristics for each edge type, and even for visible and hidden edges within each type. These characteristics include brush size and shape, dab spacing, and color, which can come from a MAX material.

Illustrate! provides a range of choices for defining surfaces as well, including None (the surface isn't rendered), Matte (the surface is rendered using background colors, but occludes any objects behind), and using the MAX material. The most intriguing choice is Toon, which uses a special shader to define the relative sizes of the shadow, main, and highlight areas. You can also specify the opacity and brightness for each, the amount of blending between each area, and how lighting affects the surface (Figure 2), and assign any map to each area's color and opacity.

To test Illustrate!, I modeled a simple rocket ship that used a multi/sub-object material and animated it lifting off and flying toward the camera. When I rendered it to a Flash file, the tail fins seemed transparent in MAX but looked fine in Flash.

The online documentation is mostly quite good, but it could use more reference material. On the plus side, it has a surplus of tutorials, some of which contain information that should be in the reference section. With its vector artwork output and expanded feature set, Illustrate! 4.0 is a very well-thought-out plug-in.

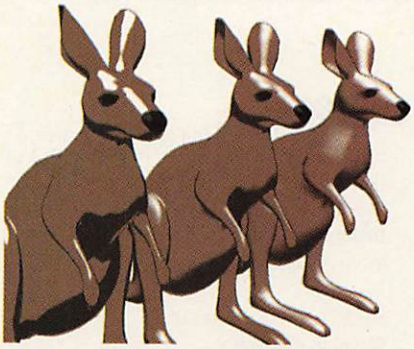

FIGURE 2. Three comic kangaroos with increasing highlight/foreground/background blending.

Woody & Leafy

Sisyphis Druid 1.1

for 3D Studio MAX & VIZ

BY DAVID DUBERMAN

Sisyphus Software's Druid 1.1 is a terrific way to add an outdoorsy touch to your 3D Studio MAX and VIZ scenes. The product comprises two plug-ins: Druid, for tree generation; and Grass, which simulates lawns and more.

The Druid plug-in lets you create just about any kind of woody/leafy forest plant you can imagine and perhaps a few you haven't. Just bear in mind that, because everything is created with geometry, polygon counts can grow quickly, along with memory requirements. Although Druid will run on a minimum of 128MB RAM, the manual suggests 512MB RAM for serious users. The tree in Figure 3 contains more than 795,000 polygons.

The six Druid roll-outs offer more parameters than I have room to discuss in depth; a couple of them don't even fit in a 1280x1024 display. You can set tree height and bounding volume by using a box, cylinder/cone, ellipsoid, or even another object's shape. You can set the trunk and branch diameter, branching density, number of branch generations, and angle between branches, and affect shape with the curl and spiral settings.

FIGURE 3. A Druidic maple tree shows its colors.

Leaf implementation is awesome: You can add four different leaf objects at any density and in five standard shapes, such as maple and oak, or provide your own types. You can set any number of material IDs for each leaf object and different IDs for the trunk and branches. And for real-world effects, you can set separate, animatable gravity and wind values for the leaves and branches, as well as wind direction, strength range, gust length, and time.

If you've used MAX's Scatter compound object (also coded by the good folks at Sisyphus), you'll be right at home with Grass. It defaults to placing the blades on its own rectangular icon, or you can spread them over any other "distribution" object. You can apply blades to vertices evenly over the surface area, along edges, at face or edge midpoints, and even to a sub-object selection. The latter function lets you create hair on a character's head (or upper lip, palms, etc.). Parameters, most of which incorporate a percentage-based variation option, include the number of blades and segments, length and width, droop, taper, tilt, and spin. If you want crabgrass (who doesn't?), you can clump the blades. For those blustery days in the burbs, Grass also provides its own wind function with the same settings as Druid.

A couple of caveats: Because Druid has so many parameters, many of which are interdependent in not-so-intuitive ways, it may take you a bit of practice to master the software. And don't even think about using these puppies for real-time applications, unless you keep the settings to an absolute minimum. Otherwise, Druid is a fine piece of work by expert plug-in producers, and I recommend it to virtual-tree huggers and their sympathizers everywhere.

Smooth Mapping

Digimation InstantUV

for 3D Studio MAX & VIZ

BY DAVID DUBERMAN

One of the trickiest aspects of 3D texture mapping is fitting a texture to an irregularly shaped object. Most programs use a one-size-fits-all solution, which generally works for regular objects—boxes, spheres, cylinders—but starts to fall down with non-conforming shapes like teapots and other real-world objects. 3D Studio MAX provides a reasonably flexible built-in texture-mapping scheme in the form of its UVW Map modifier, which lets you apply six kinds of maps: planar, cylindrical, spherical, shrink wrap (a variant of spherical), box, and face. The limit of this modifier is that it only allows you to transform the mapping gizmo and change the tiling.

Far more flexible is InstantUV, a clever plug-in developed by BackGRAF and distributed by Digimation. The product consists of a modifier, a material, and a map type, each named InstantUV. Like UVW Map, the Instant UV modifier can apply box mapping, but it can also apply dodecahedral mapping. The latter works particularly well with irregular objects by projecting a map from 12 different directions, which minimizes stretching on most surface areas. Admittedly, this solution may not be ideal for detailed, non-uniform objects like character heads, but it works well for landscape meshes, asymmetrical objects (such as a teapot), and amorphous models.

FIGURE 4. Unblended texture edges (foreground) and blended (background).

With both projection types, you can not only transform the gizmo, you can apply different rotation and offset values to each gizmo face and to overall scaling and tiling on three different axes. The gizmo faces aren't numbered, so it's a matter of trial and error to find the right one to manipulate, but each contains an arrow that accurately reflects its orientation. You can also randomize rotations and offsets, and apply two preset combos.

You could kluge this effect with a passel of planar UVW Map modifiers and a lot of work, but what you couldn't replicate is the InstantUV material's ability to blend the texture instances between the gizmo edges. For example, when you use a box-mapping gizmo, MAX projects six copies of the map onto the object, and whichever polygons face a particular side of the gizmo are mapped from that plane. If you look closely at the fingers of the foreground hand in Figure 4, which uses a standard UVW Map box gizmo, you can see the edges where different projections meet. By using the InstantUV modifier box gizmo with the InstantUV material and setting a blend factor, you can smooth the edges and make the mapping look more realistic, as shown on the background hand. On top of that, you can add a noise factor to randomize the blending. Unfortunately, you can't see the blending in the viewport; you have to render it first, and rendering can be slow because of the extra processing required for blending.

The material also has settings for blending texture edges with other UV-mapping types. The difference between the InstantUV material and map is that the former is faster, but limits you to setting all blending edges simultaneously, while the map lets you set blending on a per-map basis.

InstantUV is a bit slippery—just when you think you've figured it out, you find a whole new level of functionality. It's not a tool for beginners, a situation that's exacerbated by the manual's once-over-lightly approach. There are no tutorials, but there are a few helpful (but even more advanced) tips and tricks. If you need greater mapping power than MAX provides, InstantUV could be just what you're looking for.

David Duberman is a technical writer specializing in 3D graphics, based in Berkeley, CA. You can reach him at duberman@dnai.com.

sources

Illustrate! 4.0 · list price $395
InstantUV · list price $95
Digimation
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Druid 1.1 · list price $125
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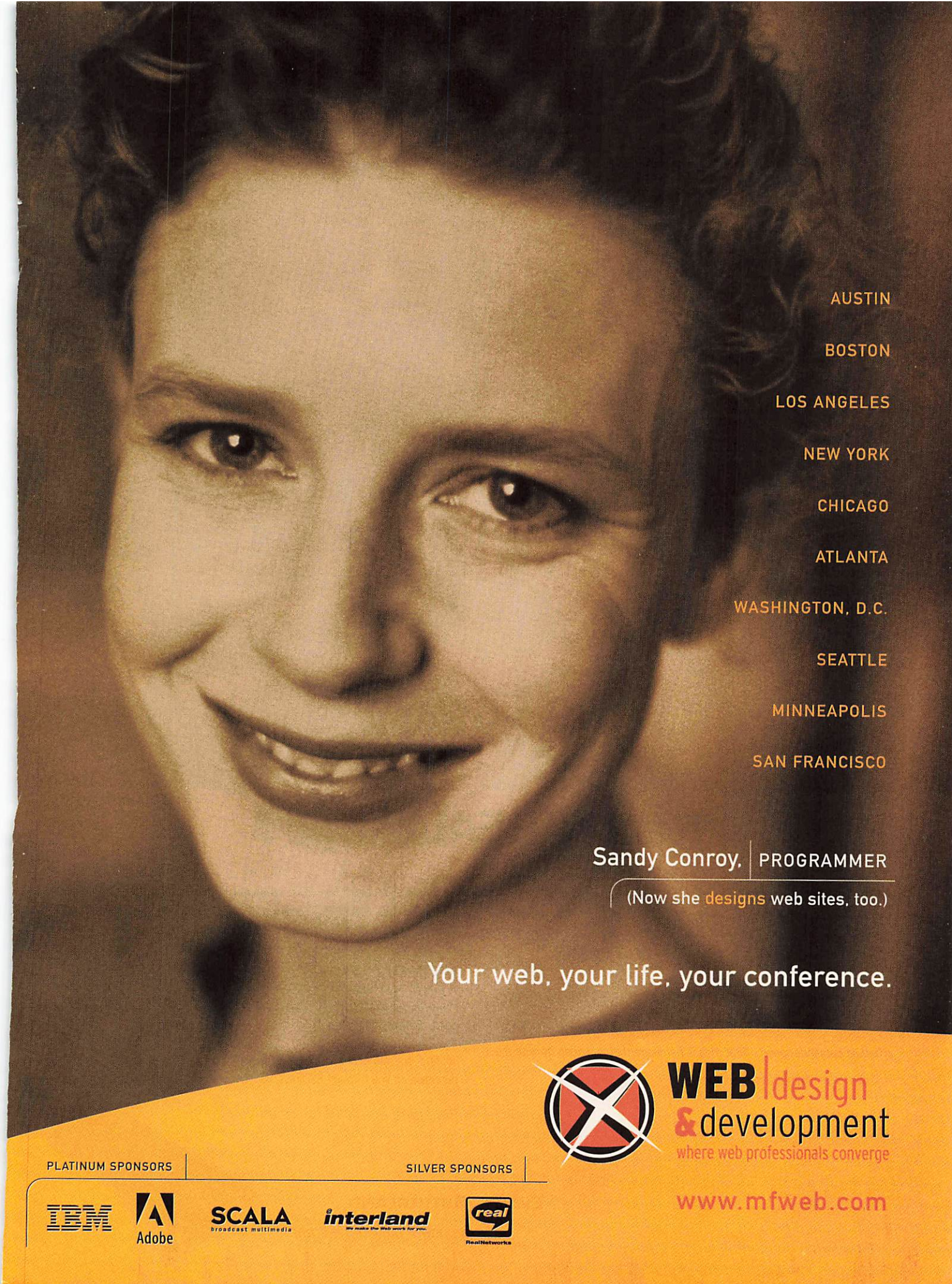
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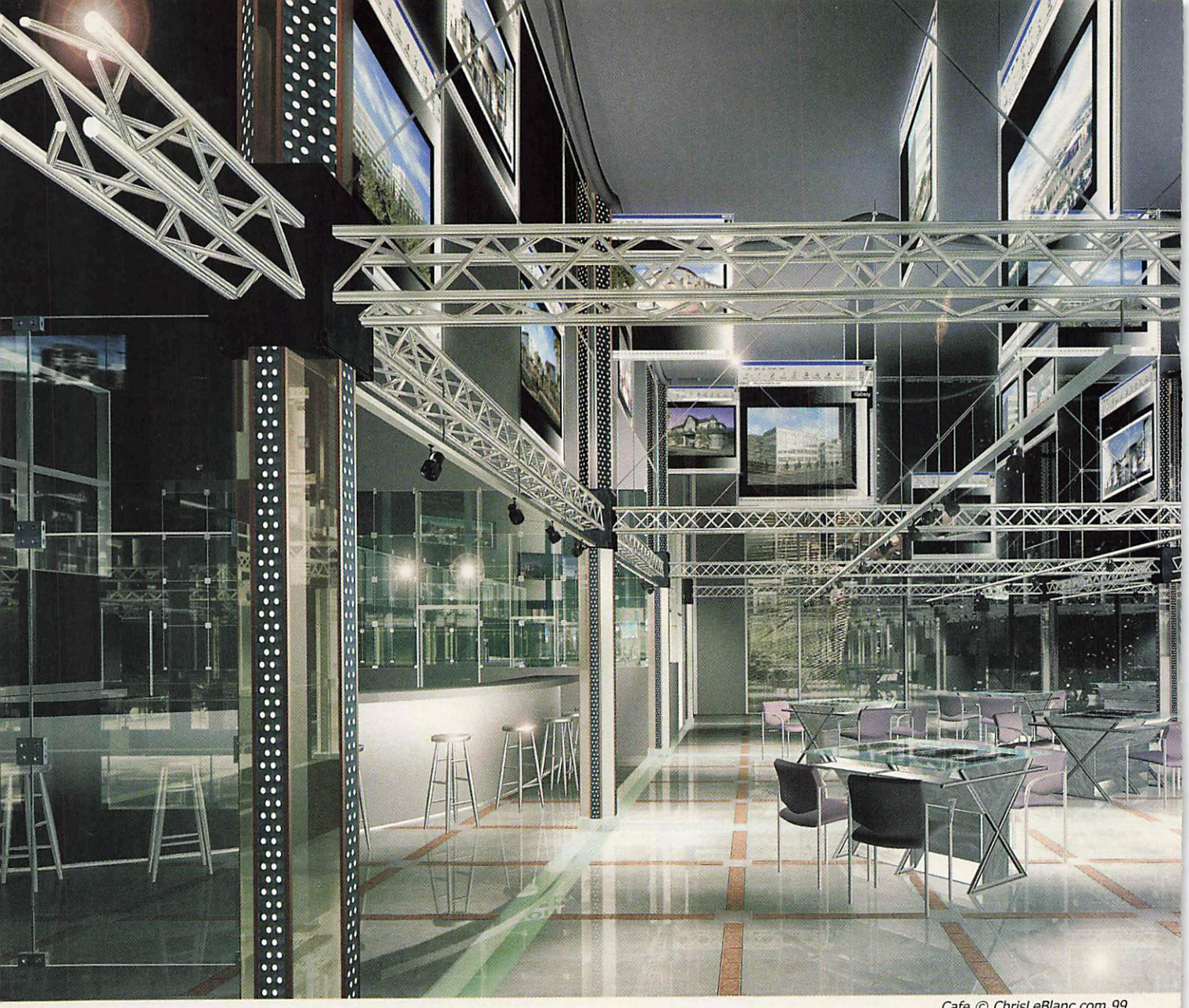

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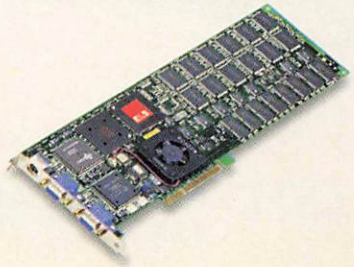

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the power behind the scenes

BY RAF ANZOVIN

Pose-to-Pose, One Sequence at a Time

Try creating and polishing just a couple seconds of animation, then moving on.

Last month, we looked at several different approaches to keyframing. Let's see how one of those approaches, a modified pose-to-pose method, is applied to a shot in my short film, *The Animator's Apprentice*.

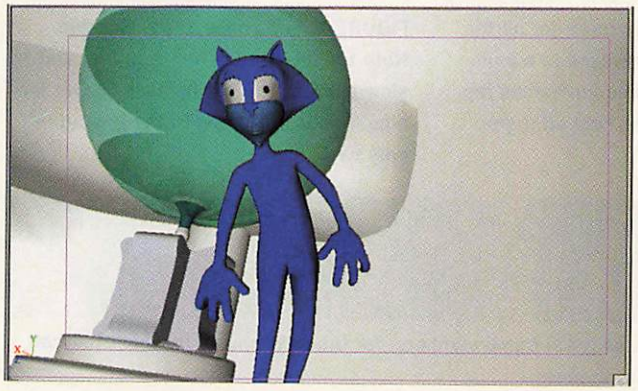
Instead of creating the poses for the entire scene to see what it looks like, then going back and finessing the in-betweens and polishing the animation—an approach favored by many animators—we'll create and polish a second or two of animation at a time. This may be a bit foreign to some of you, but bear with me.

In this shot, a blue cartoon cat is being liberated from a "holo-pedestal" where it was just created by Dennis the Dog. The zombie-like cat strains against the limits of its spherical hologram space, bursts through into reality, lands on its feet, and awakens into consciousness. According to the storyboards (Figure 1) and exposure sheet for this shot, the cat needs to hit five important poses and many smaller movements in between.

We'll begin with the action of the cat breaking out of the holosphere and landing on the ground. Figure 2 shows the key poses that were created for this action. First, we'll put down a pose of the cat inside the holosphere, just as it is about to be pulled through into the real world. Note that there is a keyframe on all the controls needed in this shot—every important control is keyed for every key pose. The next pose laid down isn't the next pose in the sequence, but the pose when the cat's feet just begin touching the ground, on frame 14. This is so we can judge the distances involved and figure out where the two poses in the middle have to be placed.

We'll put down two more key poses between the first two we just laid down. One is for where the cat shoots out of the sphere, with her body practically in a bow-shape. While she's still in the air, we'll give her a second pose where her arms and legs snap forward; because she is still lifeless, she has a floppy rag-doll quality, and the legs and arms flap around with no volition of their own.

Finally, we'll add a pose of her sagging forward after she's hit the ground, with her arms and hands snapping forward again lifelessly. After she hits the ground, we also need to add a moving hold. A moving hold is a held pose with just a slight amount of movement—a slight sharpening or pushing of the pose—that buys time for the audience to register what's going on while still keeping the character active. Adding a few moving holds in any fast-moving sequence will ensure that your audience doesn't feel assaulted by ceaseless movement. Make a moving hold by duplicating the pose a few frames later, then make it slightly more extreme by pushing the body more into the pose. Note especially that



The blue cat suddenly springs to life in this scene from *The Animator's Apprentice*.

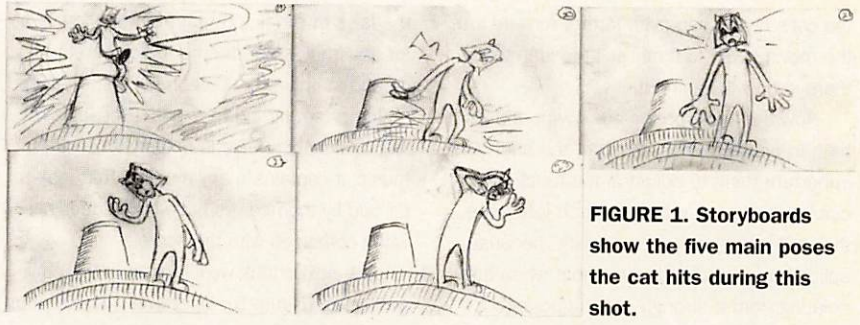


FIGURE 1. Storyboards show the five main poses the cat hits during this shot.

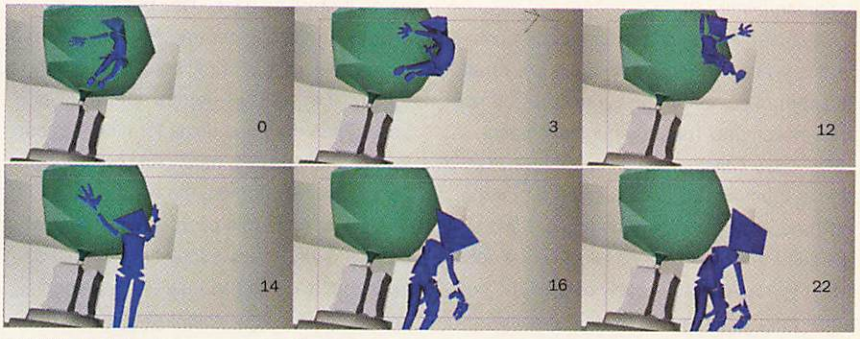


FIGURE 2. The key poses for the first chunk of animation, in which the cat is thrown violently into the real world. Using a low-res proxy model makes it easier to concentrate completely on telling the story through the character's poses. (Frame numbers are in lower-right of each frame.)

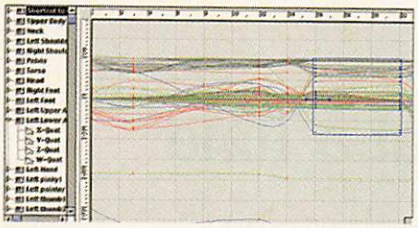


FIGURE 3. The motion graphs for all the active controls superimposed in a channel window. The selected keyframes represent the cat's moving hold after she hits the ground.

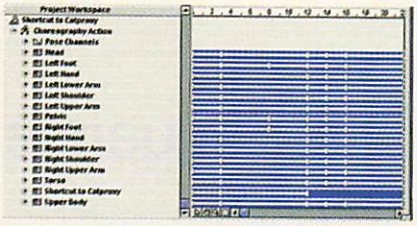


FIGURE 4. The poses in the timeline. Note the alternation between fast and slow motion: The cat holds in the air for nine frames but drops to the ground in only two.

FIGURE 5. The key poses (with frame numbers) for the next chunk, in which the cat suddenly springs into awareness.

the cat's hands flap even farther forward in the moving hold to firmly sell the idea that there is no will behind them.

Now the basic poses are down, and it's time to polish up this chunk of the shot. One important thing to adjust is the function curves during the moving hold. If left alone, they will look "spliney" or "floaty" because spline curves naturally overshoot when interpolating from a strongly moving pose to a held one (Figure 3).

F-curves for the character can be opened in one window in most programs. Select all the control points on the curves relating to that movement. Then the curves' "magnitude" (also called "weight" or "sharpness" in some apps) should be adjusted so that the spline doesn't overshoot as much. I find that it's good to keep in a little bit of overshoot when you're animating lively characters, but you'll want to remove a lot of it to achieve good, snappy motion.

In animating this shot, I found that finessing the movement involved making the timing more extreme. At first, I spaced the key poses to create a smooth movement as the cat is tossed out and onto the ground. However, with the keyframes spaced as seen in Figure 4, the movement looked far more dramatic and interesting, even if it did break the laws of physics (I had her hang in the air for five frames and then pop down to the ground in only two). This timing also matched an important hit in the music. (Because *The Animator's Apprentice* is entirely timed to music, it contains many motions that look a bit odd by themselves but work perfectly when combined with the score.)

The next chunk we'll look at is the cat waking up (Figure 5). On frame 24, she pops up as if stuck by a pin. This pose is very extreme, reflecting her abrupt change from a lifeless object to a living, conscious character, and it is only two frames after the last pose. Then the pose holds for nine frames, staying in place with hardly any overshoot. For another 39 frames, the pose simply relaxes. In total, this pose continues for several seconds. That's a long time to hold a pose, but it works because a) it's a good contrast to the very violent awakening; b) it completes a satisfying rhythm, in which the cat's motion goes from fast to slow to very fast to very slow; and c) the lack of movement in the rest of her body focuses the audience's attention on the face, which is where the interesting things are happening in this part of the shot. (We won't discuss the cat's facial animation this month, but of course all body movement has to be created with the facial animation in mind, and vice versa.)

The last chunk has her looking at her hands, as if seeing them for the first time (Figure 6). The pose in which she looks at her left hand is held with a very slightly moving hold until frame 101. To polish up this section, we'll use an important technique called offset. In Figure 7, you can see the timeline of this section. The key pose keyframes no longer look like an unbroken column. They've been offset to produce a more interesting movement. Her body hits the key pose on frame 79, but her arm reaches its pose two frames later, the hand reaches its pose two frames after that, and the fingers reach their pose two frames after that. This produces a nice rolling movement in the hand as she brings it up. It's very important to keep this technique in mind when using pose-to-pose with lively characters because the pose can end up looking quite robotic if all the elements hit the pose at once. The right hand moves much the same way.

In the completed shot, I decided it was unnecessary for the cat to place her left hand on her head, as in the storyboard. If I hadn't done an animatic, I probably would have wasted time animating the hand-on-head motion before I realized that it didn't work—just one more example of the need for proper preparation and timing.

Next time, we'll look at secondary actions such as the movement of tails, ears, and clothing.

Raf Anzovin is the co-founder of Anzovin Studio, a character animation house based in Amherst, MA. Contact him at raf@anzovin.com.

FIGURE 7. Offsetting keyframes on important bones in the key poses is essential to attaining fluid movement. In this case, the cat's arms and hands enter and leave their key positions several frames after the rest of the body.

FIGURE 6. In the final chunk, the cat is puzzled by her surroundings.

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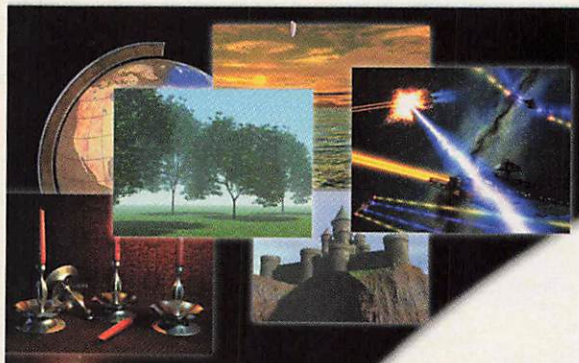

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BY ROB NEDERHORST

Lighting Without Lights

Don't be in the dark about working with gradients & reflection cards.

This month's topic is a lighting technique that involves—well, no light. For most projects, using the "no lights" method throughout isn't an option, but you'll find it valuable in lighting certain objects and materials. This technique uses reflection objects (or cards) and gradient textures (or grads) to simulate light in a scene. The software I'll be using is NewTek LightWave 3D 5.6, but almost all these ideas translate quite well to other packages.

The type of lighting I'm going to simulate is studio lighting. It offers the most pristine environment because the photographer has absolute control. Studio lights, or softboxes, are regular lights enclosed in a box with fabric over the front. The diffused light creates a very soft specular effect with a nice fall-off. Most professional product shots (for example, a watch or a stereo) are lit with softboxes.

The first thing we'll need for our studio is a subject. In this case, a bottle will do. Make a couple quick polygons to represent a table and a wall behind the bottle (Figure 1). I modeled water in the bottle as well, so we can get more accurate refractions and see a meniscus in the bottle.

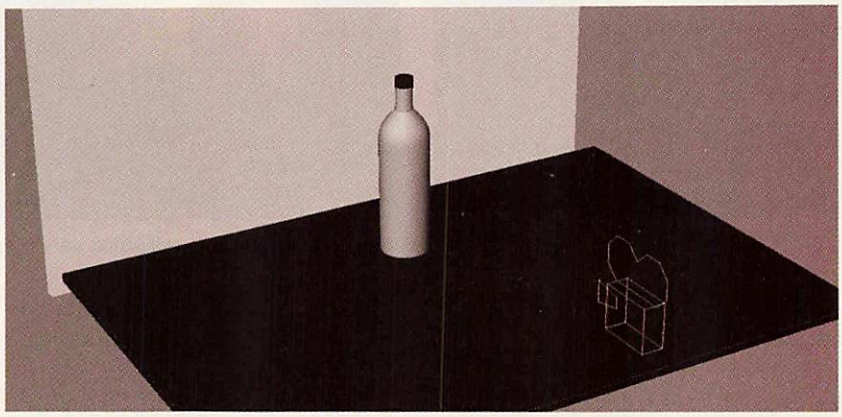

FIGURE 1. The scene we are lighting without lights.

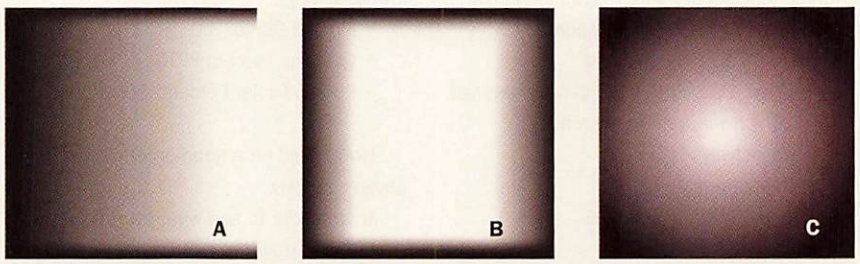

FIGURE 2. The gradients: the side cards (a), the front card (b), and the wall (c).

Turn Off the Lights Let's get on with the lighting. Set your ambient light at 2-3%. You almost never want to use too much of this stuff—it can create a really washed-out effect. It's a quick way to fake radiosity, but we don't need any in this scene. To see how powerful the reflections can be, make sure there are no lights in the scene; if there are, turn their settings to 0%. Now you should have the bottle on the table in front of the wall. Can't see it? Good. We'll fix that in a minute.

The way to make lights is by using flat polygons (or curved objects) as reflection objects or cards in the scene. We're going to make those objects luminescent, but we'll use maps to define the way the reflected light falls off. The maps are gradient textures (grads) we'll make in Adobe Photoshop. Using procedural grads as maps is another solution that allows for faster updates of the reflection maps. I leave the detailing of the maps up to you. I created mine using Photoshop's Gradient tool (Figures 2a–c). Note that I made a grad for the wall because the bottle has to refract some type of "light."

Figure 3a shows how the wall map is used. It's a planar projection on the Z axis automatically sized to the maximum size of the polygon. To see the two side reflectors, check out Figure 3b. I planar-projected the side grad on the X axis. Last but not least is the front card in Figure 3c. The Z-axis planar-projected image helped bring out the bottle cap a little. I used curved shapes so that my reflections would work out a bit better. I made a subdivided plane for each side of the bottle, and bent it to get better reflections around the bottle's curved surface. These act like two lights on the sides of the bottle, so we can show off the edges of our liquid-holding buddy. I also made one for the front of the bottle to help emphasize the cap.

Set the Surface So, now everything should be great right? Well, almost—we need to get our surface settings right for our bottle, cap, walls, and so on. Let's take a look at the reflector cards and wall first, since they will have the same settings. Aside from the settings in the following list, keep all other surfaces at their default settings:

- Color texture: (pick which map is right for the surface)
- Luminosity: 100% (you can also experiment with using the color grads as luminance maps)
- Diffuse: 0% (this is so we don't have lights affect our reflector cards.)

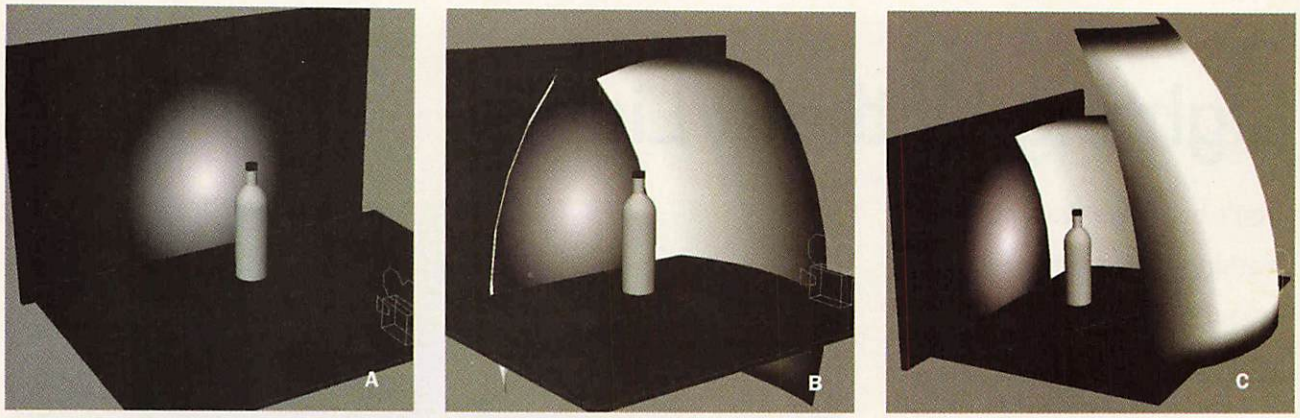

FIGURE 3. Our scene with the wall grad applied (a), adding the side reflection cards (b), and adding the front grad (c).

All the other parameters are set to 0% because we don't need them.

With that in place, we can concentrate on the bottle and liquid. You'll need to consider the properties of the bottle's glass surface. I used a Fresnel shader to get the results I wanted (check out Pontari's Fresnel Add, a free shader available at www.pontari.com). Here are my surface settings:

- Color: 200, 200, 200 (default settings, which will work in this case)
- Reflectivity: 100%
- Transparency: 95%
- Index of Refraction: 1.5

Let's add the Fresnel shader. Here are its settings:

- Effect Reflection
  - Fresnel Curve: 3.5
  - Glancing Percent: 20
  - Perpendicular Percent: 0
- Effect Transparency
  - Fresnel Curve: 3.5
  - Glancing Percent: 10
  - Perpendicular Percent: 95
- Effect Diffusion
  - Fresnel Curve: 3.5
  - Glancing Percent: 20
  - Perpendicular Percent: 0

If these settings seem a bit daunting to you, have no fear—I'll go over them in a future column dedicated to shaders and the like (which means ya gotta stay tuned!).

I used the same settings for the liquid as well. I didn't opt for the Fresnel shader, simply because I wasn't getting the results I wanted with it on the liquid. Be sure to get the index of refraction in the liquid's surface.

That'll go a long way to getting you what you're looking for. Now let's look at the settings for the bottle cap. We'll set our parameters in keeping with its chrome-like surface:

- Diffuse: 0%
- Reflectivity: 100%

We'll add Pontari's shader using the following settings:

- Fresnel Curve: 3.0
- Glancing Percent: 100
- Perpendicular Percent: 30

Now would be a good time to save if you haven't already.

Try a render to see what you think. Need something extra? We need to make the floor look a bit cooler by adding the bottle's reflection. Here are my settings for adding a reflective surface to the floor:

- Diffuse: 0%
- Specular Level: 95% (although you don't really need this, I adjusted it out of habit and to test out how my noise bump map would work without having to use reflections)
- Reflectivity: 80%
- Bump Map
  - Fractal Bumps
    - Texture Size
      - X: 5mm
      - Y: 1m
      - Z: 100m
    - Texture amplitude: 10%
    - Frequencies: 5 (this isn't moving, so we can keep this number high)

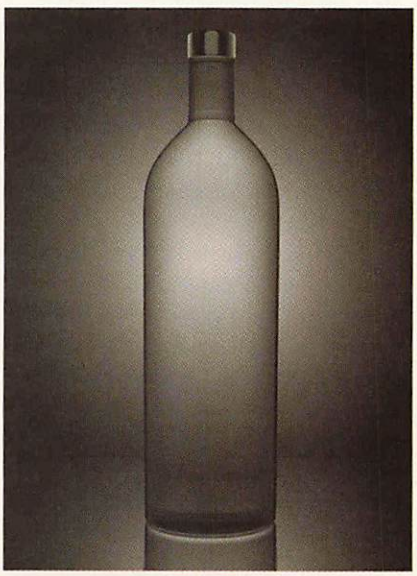

FIGURE 4. The final render.

Now let's go to the Objects panel. Make sure all your reflection card objects (the side and front ones) are marked unseen by the camera, since we don't want them visible.

Try rendering the scene again. You should have something similar to Figure 4. If you don't experiment with the settings, definitely examine the grads you made to see how they affect the final render. These grads can make or break the final rendered image, so spend time making them work. It will be tough the first time or two, but you'll get the hang of it. You'll use it quite a bit more than you thought you would. I recently employed this method in a credit card commercial where I had to make plastic (Lucite) match practical photography. Worked like a champ! A simple grad (OK, I added some noise) on a half-tube created enough cool reflections and refractions to make the piece look realistic. I have no doubt that you, too, can make your images look really killer. Until next time... render on!

Robert Nederhorst is a pixel coordinator and rendermonkey #3 at Digital Domain. You can contact him at throb@d2.com.

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BY CHRIS TOME

3D3K

I slide my finger down the groove on the small, black, obelisk-shaped device, and the interface nodes from my temples and right hand disappear inside, the case once again becoming as smooth and hard as obsidian. My eyes reorient to the sunlight, and I look out

I'm a 3D intellispace designer at NeuroSpace Inc., one of the oldest creationist companies.

across the park. Ah, the island of San Francisco, one of the few real places I would ever want to be. Much of the world had become ugly and dilapidated because no one seemed to care much about the real world anymore. At least San Francisco, a bastion of high-tech for more than a thousand years, had been rebuilt with more splendor than ever before after The Big Kahuna, a nine-point-something earthquake that leveled the entire city in the late 2300s.

Most of my colleagues thought I was nuts to work outside, surrounded by actual trees, sitting on real grass, and breathing real air. I could have any type office in any environment I wanted. I could build it myself, buy a pre-fab space from companies like Subject2Vue, or pick from literally thousands of free modules on the network. I could work on the top of the Eiffel Tower if I wanted, but there was only one problem for me—it wasn't real.

I'm a 3D intellispace designer—and one of the finest around, if I do say so myself—at NeuroSpace Inc., one of the oldest and most respected creationist companies. (Their slogan is: "God is in the details, and we'll find him one day.") The entire earth is linked, everyone has free access, and computers are mostly disposable—you can grow new ones from simple sand as needed. Most people understand that the worlds they inhabit on the GaiaNet network are fabrications, but they're so real, so tactile, they suspend all disbelief. Some actually lose their minds in the artificial reality of the network, never to return.

That's my life, designing worlds that don't exist. I use a top-of-the-line 80THz CommDell neural tracer, an AI spatial and relational 4D database, and corneal 3D mesh generator implants to create my 3D worlds. Coders link it all up to GrayMatter™ data-mining servers at the core of GaiaNet. These units correlate human sensory needs with the information being processed, simple by today's standards.

Technology to read and write neural impulses directly into the human brain has been available for centuries. Technology hadn't changed much since the early 2400s—quantum computing and artificial intelligence gave rise to machines capable of not only independent thought, but of self-replication. Only recently have we understood the intricacies of computers not invented by human beings.

The tricky part of augmented reality, though, had been figured out less than a hundred years ago: the ability to control nerve impulses the brain relays to the physical host body. After that problem had been solved, people disappeared into their altered existence by the billions, and the world became a much quieter place. At least this world; we lost contact with the outer colonies centuries ago. That alone has been the subject of many GaiaNet sims I have encountered in my travels.

The next step in this global immersion is something I am furiously working on: imagined reality transmuted into the virtual world. I've spent the last five years looking out through the eyes of others, piggybacking their neural traces, seeing what they saw, not what I thought they did. The experiences shared one quality: they were completely unique. The challenge: to turn those subjective, imagined visions into a tangible virtual experience. I had asked, What if the traces of neural data that allowed one to see into their imagined worlds could be recorded, processed, made three-dimensional, and projected directly into the mind of another? Once the issue of keeping the computers in sync with the brain were worked out (which was not easy, painless, or physically safe for some unwitting volunteers), we were ready to share minds, ideas, and thoughts on levels previously unexperienced. True harmony with everyone on the planet—that's the idea.

My job is to translate these visually warped two-dimensional images into fully realized 3D forms, ones that would be indistinguishable from reality unless dictated otherwise. I've spent years teaching the network about form, shape, and vision, tweaking thousands of datasets to build an intelligent engine capable of re-creating everything from fractal patterns of life to imaginary fantasy creatures. The coders would have to figure out the interface side. I help GaiaNet process and serve that 3D data out to others connected to the global whole.

We turn on Gaia's Ghost, as we call it internally, in exactly 71 days, at 11:59 P.M., year 2999. I'm a bit concerned about my work and its implications for all of humanity, but I must go on. Perhaps I, more than anyone else, desire to see what's inside others' minds. I need to experience the unknown. Only time will tell, but I believe we are reaching a turning point, a place where I will help shape a future in which all of humanity benefits. Where people understand themselves and others on such a fundamental level that we can all share a collective consciousness and expand our minds beyond the confines of our own perceptions.

As we turn the page to a new millennium and seemingly unlimited possibilities, I find myself once again in the park, but not truly outside. This will be my office for the rest of the day, realizing as I look around that it isn't real. Or is it? Does it matter? That question will have to await analysis. I have tons of work left to do, and these 80THz neural computers are still too damn slow.

Chris Tome is technical editor for *3D* magazine and would like to thank Asimov, Clarke, Adams, and Gibson for many hours of fine reading. Tap into GaiaNet and email him at ctome@mfi.com.

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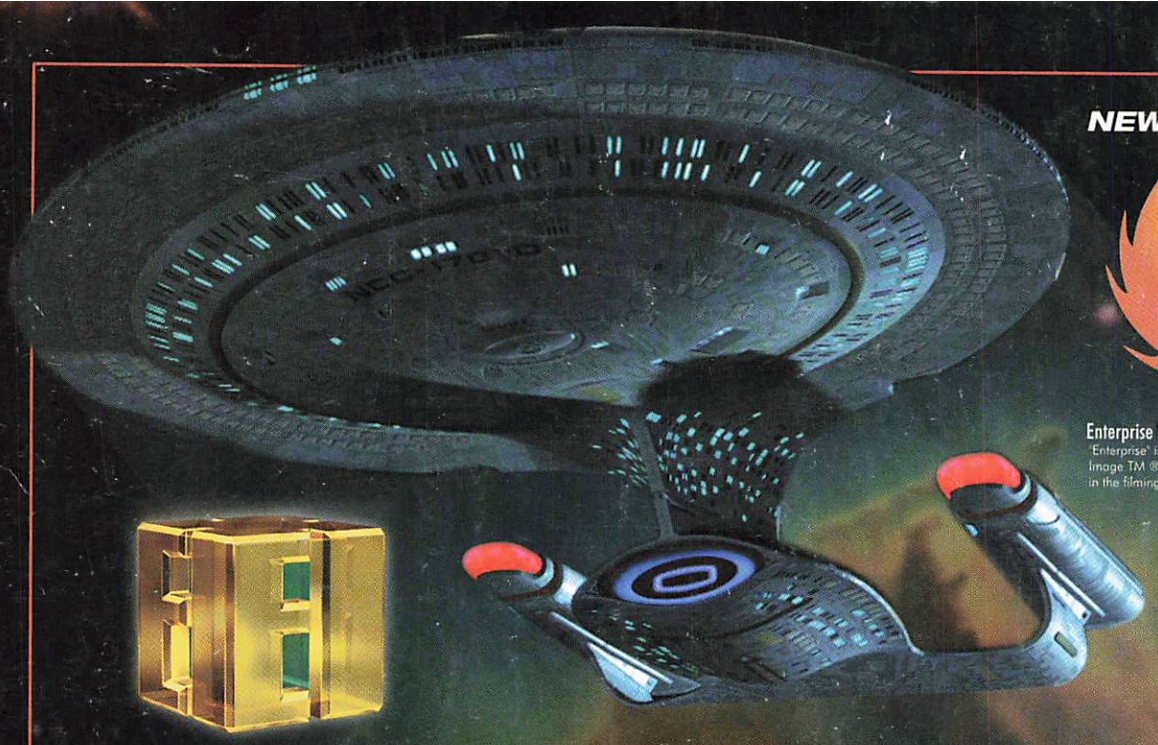

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